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THE PRACTICAL ENGINEER

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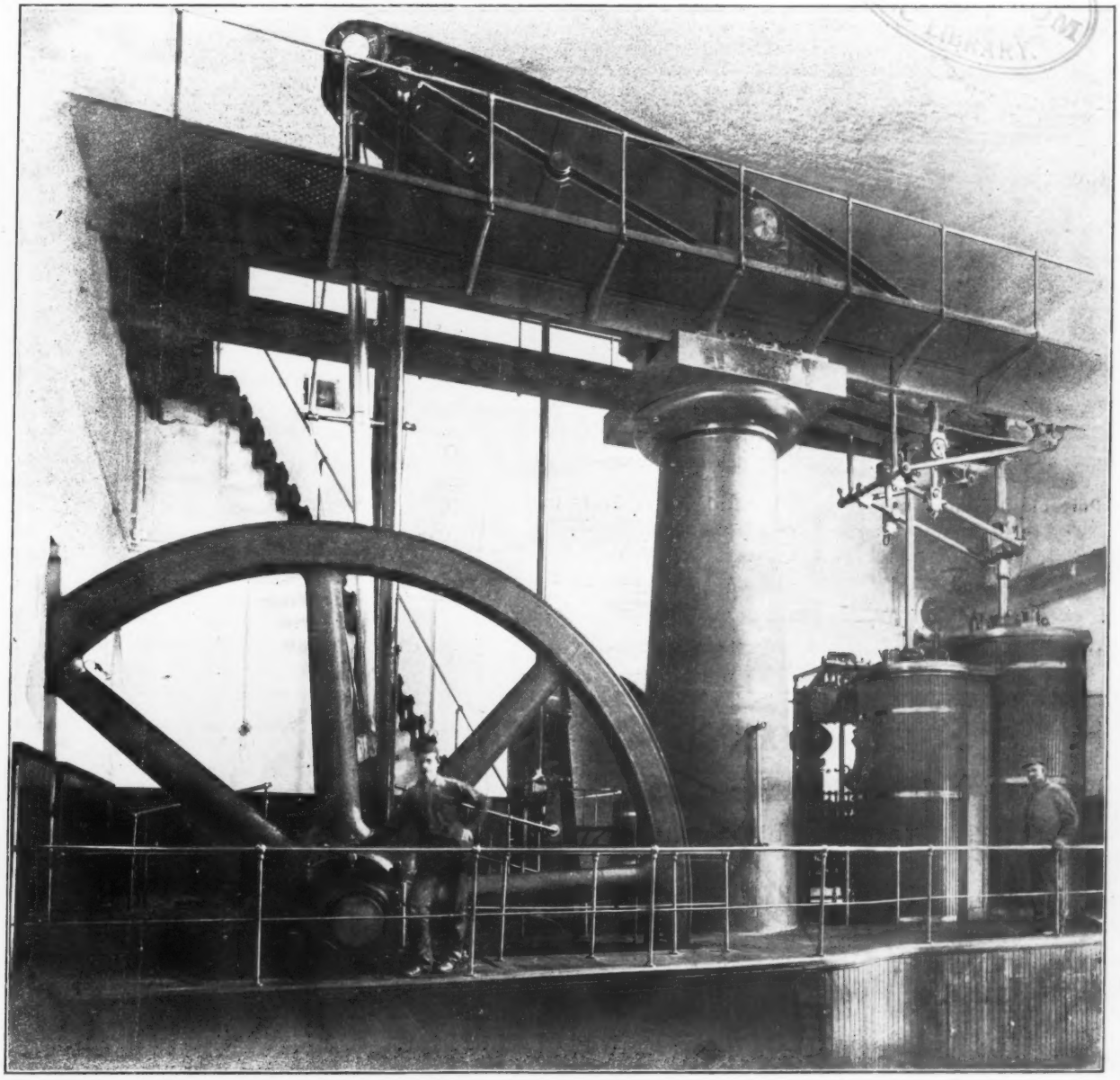

AN OLD PUMPING ENGINE.—See page 4.

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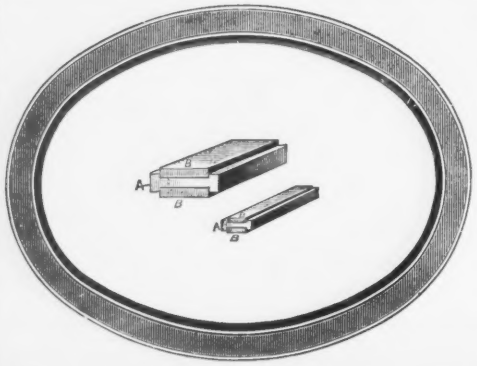

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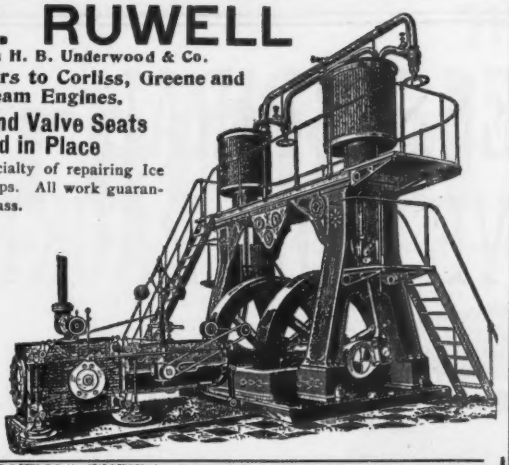

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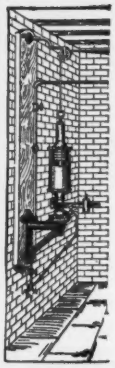

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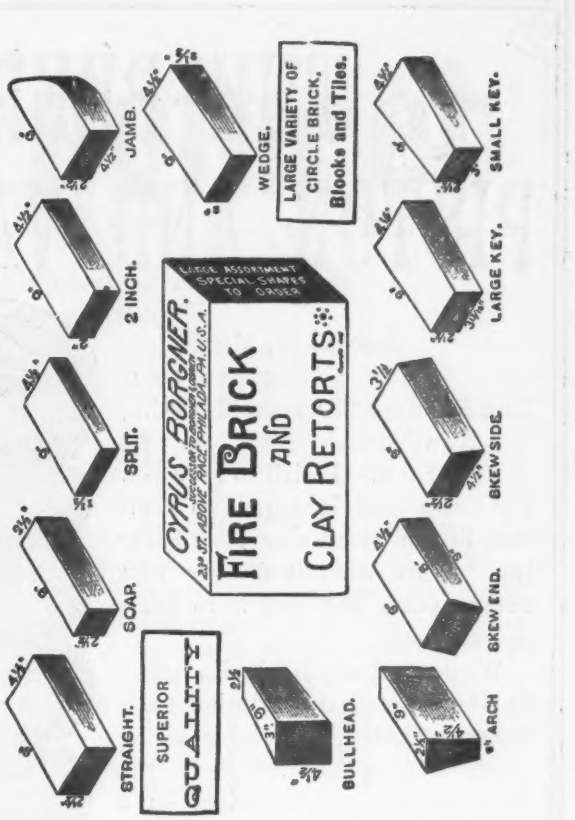

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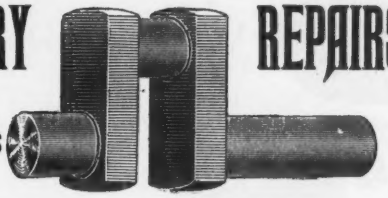

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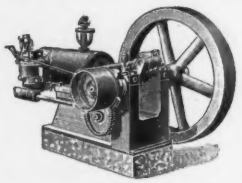

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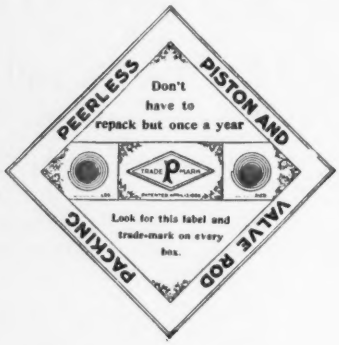

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The
Practical Engineer

A monthly journal, devoted to the economical generation and utilization of power and to the interests of stationary engineers

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HARD, vs. SOFT COAL

BY W. H. WAKEMAN

A correspondent, who is engineer of a large plant in another city, writes that he is "trying to burn Welsh coal," but the only way they can do it is to mix it with American coal," and adds that he has found it necessary to start up another boiler in order to make steam enough to run the engines.

There are undoubtedly several grades of Welsh coal, some of which are better than others, and this engineer may have been unfortunate enough to get some of the lower grades which accounts for his dissatisfaction, but this is only incidental, as the fact that he was obliged to start up another boiler is the point that I wish to call attention to.

Are there not many plants where it would pay to "start up another boiler," and in some of these cases it is necessary to add "if they had it."

Has the extended use of soft coal during the past decade or two, proved a blessing or a curse? It has enabled us to force boilers more than was possible, while burning hard coal, but how much has the change improved matters, when we consider the subject from every point of view. It has made it possible to run with three boilers where we formelry required four, but is the fourth boiler held in reserve to be used when one of the others must be cleaned or repaired? It may be in some cases, but in many others additions have been made to the machinery in the factory, and higher speeds adopted for that already in use, until the fourth boiler is worked as hard as the others, leaving the fireman no chance to clean any of them, except on Sunday, or some holiday, when he ought to be enjoying himself elsewhere.

Those four boilers formerly required four tons of hard coal per day, but now the dealer delivers eight tons of soft coal per day, and one man must shovel all of it, or give place to somebody else who will do it. Of course this makes a better showing when inventory is taken and the profits counted up, or at least it apparently looks better; but is it a real advantage, all things considered?

From the fireman's point of view, it is as follows: He formerly fired those boilers, kept his boiler, in good order, and cared for pumps, &c., in a way that made it a pleasure to visit his boiler-room. He took great pride in his work, felt that he had much responsibility resting upon him, and made others feel that he had a place worth aspiring to, for he was firmly convinced that no ordinary man could fill his place, and this went far towards making others believe that he was right. He held his position for years, was loyal to his engineer, and believed that his employer was a friend whose good will was worth something.

All this is changed now, for work in the boiler room is so hard that only a man in the prime of life can stand it, and he grows old before his time. The new fireman has no time to clean his boiler fronts, or do more than oil his pump, for his whole time is occupied in keeping up steam, for if it drops five pounds he has hard work to raise it. Dust and ashes rest upon every pipe, valve, and fixture in the room, while it requires very good eyesight to locate the water level in the gage glasses.

The fireman works steadily, but is watching just as steadily for another job, as he knows that it will be impossible for him to do the work here, except for a short time. He will work the engineer out of his job if he can, and considers his employer unworthy of respect. The conditions under which he is forced to labor has made him what he is, and no further comments are necessary on this point.

It is claimed by some men that while this state of affairs may not be as agreeable as might be desired, it proves a paying plan, and that is what manufacturers are in business for, and that only. For the sake of argument, we will admit the latter, but take exceptions to the former.

For illustration, take a plant, well known to the writer, that was equipped with two large vertical water tube boilers. They were forced so hard that the stacks above the roof were red hot frequently, and the composition disk in the main stop valve, located near one of these stacks, was melted by the fierce heat. It required an exceptionally good fireman to maintain the required pressure, and even then it was impossible to do it when the fires required cleaning. Firemen were sometimes obliged to give up the job without notice, and others would stand it for a day or two after deciding to leave. The entire plant looked like a wreck, because there was no time to do anything, except shovel coal and clean fires.

After some unpleasant experiences along this line, it was decided to put in another boiler, and now it is possible to keep up steam at all times. In the mean time a new superintendent took charge, and proceeded to introduce some changes that have proved beneficial and greatly increased the product of the mill. So far good, but he talks of laying off one boiler and making steam for the whole plant with two, as formerly. This

means red hot smokestacks, &c., ,but illustrates the mania for forcing boilers which prevails in many places.

Now if hard coal was the only kind available, it could not be done (without forced draft,) the consequence of which would be that one or two more boilers would be installed, no red hot smokestacks would be in evidence, the fireman would not live in torment, and furthermore the bill for coal would be less than it now is.

I am well aware of the fact that with more boilers in use, the amount of permanent investment is increased; hence the charges for interest must be higher, but the depreciation of plant is less, and the saving in fuel will be more each month than the extra interest account for a whole year.

Notwithstanding numerous experiences along this line, one of our best known consulting engineers has planned and erected a plant not far from where I write, where three large tubular boilers should have been used, and four would be better still, but only two were installed, yet the plant must be run 24 hours per day and 7 days per week, for a greater portion of the year, making it impossible to clean or repair boilers without shutting down.

Strenuous efforts made to increase the capacity of these boilers included the addition of another row of tubes above those that the boiler maker knew by long experience, to be as high as good practice would admit. This reduced the steam space and made the boilers foam without making them large enough to be satisfactory. Space might have been left for another tubular boiler, but the prevailing mania for crowding steam plants into the smallest possible space prevented it; hence a vertical boiler has been installed, as the only available plan for increasing the steaming capacity, but it makes a combination that is far from desireable.

The steam pressure could not be maintained in this plant if hard coal was burned, but by nearly constant efforts of the fireman while burning soft coal, it is barely possible to do it.

Some engineers point out the fact that plants are operated now with less boilers than formerly, and claim that this denotes progress in steam engineering, but I am much inclined to think that this progress is more imaginary than real, just as it is along some other lines in steam engineering.

In another plant a very large water tube boiler was installed, rated at 1, 200 horse-power, but it has frequently been forced to develop 1,700 horse-power. Perhaps I am mistaken, but there appears to be a note of pride in the verbal accounts given of such performances, which may or may not be justifiable, but in my opinion all such abuse of a steam plant is to be deplored on every convenient occasion.

Constructing boilers to carry high pressures with safety is proper and indicates true progress in steam engineering, as high pressure steam is much more economical than low pressure, yet the total heat it contains is but a trifle more. Appliances for utilizing waste heat, thus reducing the temperature of escaping gases, or in other words, lowering smoke stack temperatures, are certainly a step in the right direction; but the practice of forcing stationary boilers to agree with what some people call "modern practice," is only imaginary progress, therefore is not real and consequently not worthy of recognition.

The addition of more boilers will reduce the coal bills in hundreds of plants, and give satisfaction accordingly.

An Old Pumping Engine

The illustration on the front cover of this edition of "THE PRACTICAL ENGINEER" shows a type of pumping engine which is so old that it will appear new to most engineers. It is an engine known as a compound cylinder condensing bucket and plunger engine of the walking beam type. It was designed by Frederic Graff in 1870, who was at that time Chief of the Water Department of Philadelphia, and was erected in the Spring Garden Pumping Station, Philadelphia, by the Southwark Foundry Company during the same year. Since that period it has been in almost continuous service, pumping an average of 10,000,000 gallons of water per twenty-four hours.

The high pressure cylinder is 36 inches with a stroke of 5 foot 2 inches. The low pressure cylinder has a diameter of 57 inches with a stroke of 8 feet. The pump plungers are two in number 28½ in. diameter with an 8 ft. stroke, and are operated from each end of the beam; that on the cylinder end being a direct continuation of the steam cylinder piston. The steam pressure used is 75 pounds and the machine pumps against a back-pressure of 38 pounds. The centre column of the engine supporting the beam is used as an air chamber to pump against. The engine proper is really but slightly dissimilar to the type used in operating our side wheel steamers, with the exception of the addition of the pump plungers.

The valve gearing is operated by a set of eccentrics on a shaft, which is given rotative speed by bevel-gearing from the fly-wheel shaft. It is so arranged that in case of accident the cut-off may be stopped by throwing off the friction clutch. The speed of the engine being only 14 revolutions per minute makes the eccentric system of cut-off not nearly so wasteful of steam as it would be on a higer speed engine, hence this engine, old as it is, operates in the line of economy, very close to those of much newer design working side by side with it.

* * * *

A Hot Water Boiler Explosion

On February 12th a hot water boiler 60" by 8' exploded at the Medico Chirurgical Hospital, Philadelphia. The result of the explosion was a complete wrecking of the lower part of the southern wing of the building. That, a great loss of life did not occur was due to there being a light shaft immediately over the boiler and, following the line of least resistance a great portion of the force was spent in blowing out the skylights, thus saving the sidewalls of the building. As it was, while no one was killed, a great number of patients were shaken up, and frightened nearly to death, by having plaster partition walls scattered over their beds and in many cases the beds overturned. However, no one was seriously injured.

The tank that exploded was heated by live steam from the boiler house introduced through a reducing valve which maintained a pressure, it is said, not exceeding fifteen pounds. The force of the explosion would indicate, however, a much higher pressure. In some parts of the bursted boiler the metal had worn away until it was scarcely 1-32 in. in thickness. But, as there was no leak, and no man-hole in order to permit interior inspection, these defects could not be discovered only by a rupture of some kind.

Tests of Riveted Joints

While the strength of riveted joints have always had set allowance by the insurance companies and other boiler inspectors; yet, until recent years investigations into strength of such joints have been more mathematical than experimental, as no machines were in use capable of pulling wide joints or

Fig. 1

large sectional areas, as is now made possible by the installation of large testing machines at some of our principal steel works, and especially at the Watertown Arsenal.

The tests made upon iron and steel bars, plates, and riveted joints for the United States Navy Department, which extended over several years at the Watertown Arsenal, are the most extended and comprehensive ever undertaken in this country. As these tests were undertaken for the purpose of ascertaining how riveted joints fail, a number of engravings are here introduced, copied from the records of the arsenal, which, in connection with the tabulated data, give much valuable information regarding this important detail in steam-boiler construction.

A riveted joint may fail by (1) the shearing of the rivets (Fig. 1), in which the rivet area and shearing resistance are too small for the thickness of plate and pitch of rivets; to remedy which a larger rivet may be introduced, or, in case of iron

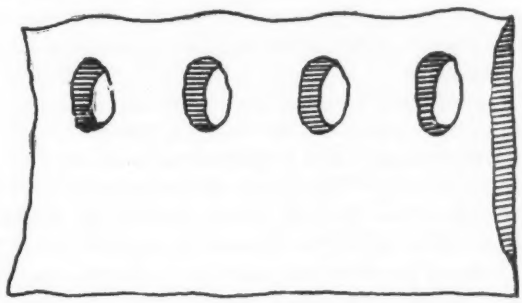


Fig. 2

rivets, the substitution of steel rivets, the latter having a shearing strength more than 20 per cent. greater than iron rivets. The engraving (Fig. 2). is a typical illustration of the elongation of rivet holes where the rivets were sheared by the plate. This illustration was prepared from a tracing drawn over a photograph of a joint in a $\frac{5}{8}$ inch steel plate with $1\frac{1}{8}$ rivets on $3\frac{1}{8}$ inch pitch. The elongations of rivet holes were 0.64, 0.68, 0.73, and 0.83 decimal parts of an inch respectively.

(2). By crushing and tearing out the plate in front of the rivet (Figs. 3 and 4). This method of failure depends usually upon the thickness of plate relative to diameter of rivet. Such a fracture suggests that smaller rivets be used if the distance from the edge of the plate to the side of the hole be not less than the diameter of the hole. The engraving (Fig. 4), was made from a tracing drawn over a photograph of a steel plate $\frac{1}{2}$ inch thick with 5 11-8 rivets on $3\frac{1}{8}$ inch pitch. The plate tore out in front of the rivets as shown.

(3). By tearing the plate along the line of the rivet-hole

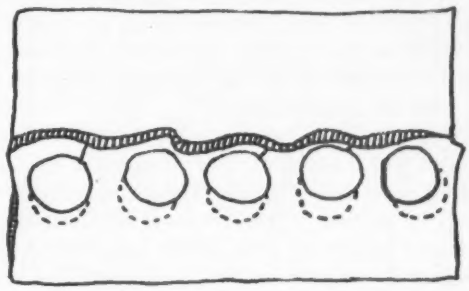


Fig. 3

(Fig. 5). This fracture depends upon the thickness of the plate and the pitch of the rivets. The resistance to this mode of fracture equals the effective sectional area of plate between holes multiplied by its tensile strength per square inch. The engraving (Fig. 5), was made from a tracing drawn over a photograph of a steel plate 5-16 inch thick with 1-inch drilled

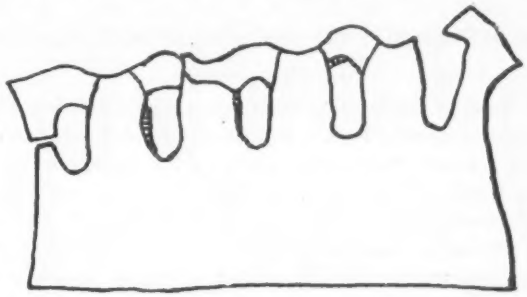


Fig. 4

holes on $3\frac{1}{2}$ inch pitch. The efficiency of this joint was 80.1 per cent.

A riveted joint should fail preferably by fracturing the plate along the line of rivets from hole to hole; if failure should occur by either of the first two methods it indicates an excess of strength in the net section of the plate through the line of rivet-holes which has not been made use of; if, on the other hand, fracture occurs along the line of rivet-holes in a well-proportioned joint, it is immaterial whether there is an excess of strength in other directions or not.

It was observed during the tests of riveted joints at the Watertown Arsenal that the failure of a joint was generally marked by three well defined periods. In the first period the

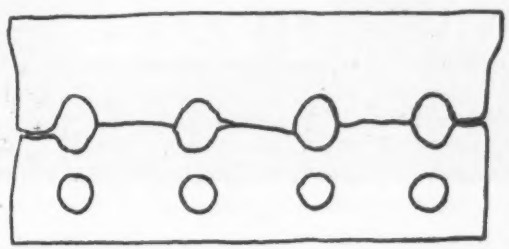


Fig. 5

greatest rigidity was found, and it was thought that that joint was then held entirely by friction of the rivet heads, and the movement of the joint was principally that due to the elasticity of the metal.

The second period was distinguished by a rapid increase in the strength of the joint, attributed to the overcoming of the friction under the rivet heads and closing up any clearance about the rivets, bringing them into bearing condition against the fronts of the rivet-holes. Rivets which are said to fill the holes can hardly do so completely, on account of the contraction of the metal of the rivet from a higher temperature than that of the plate after the rivet is driven.

After a brief interval the movement of the joint was retarded, and the third period reached. The strength of the joint was then believed to be due to the distortion of the rivet-holes and of the rivets themselves. The movement began slowly, and so continued until the elastic limit of the metal about the rivet holes was passed, and general flow took place over the entire cross-section, and rupture was reached.

These stages in the test of a joint were well defined except when the plates were in a warped condition initially, when abnormal micrometer readings were observed. The difference in behavior of a joint and the solid metal suggested the propriety of arranging tension-joints in boiler construction and elsewhere as nearly in line as possible.

* * * *

Electrical Machinery for Operating Gold Dredges in the Klondike Region

The Western Engineering and Construction Company, of San Francisco, is about to install, in the territory south of the Yukon District, a power transmission plant for the operation of a gold dredge, which will be erected at Atlin, B. C., two miles distant from the power plant. This is a new development in the methods of mining in this region, which is a very important placer district, and much gold that would otherwise be lost will be saved by the use of electrically operated dredges. The work to be done here is similar to that carried on at Oroville, Cal., although the gold is coarser in the Atlin District, being found in nuggets from the size of a pinhead to that of an ostrich egg.

The electrical equipment for this plant consists of the following apparatus, recently purchased from the Westinghouse Electric & Mfg. Co. : Two 180-kilowatt belted alternators, which are to be driven by water wheels; two type F. variable-speed induction motors with controllers; two standard type C induction motors for driving the pump, one of 20-horse-power, and the other of 50-horse-power; and a 15-horse power, type C motor for operating screens. It is interesting to follow the route over which this machinery will pass before reaching its destination at Atlin. From the East Pittsburg works of the Westinghouse Company, the apparatus will be shipped directly across the continent to Vancouver, B. C., from which city it will

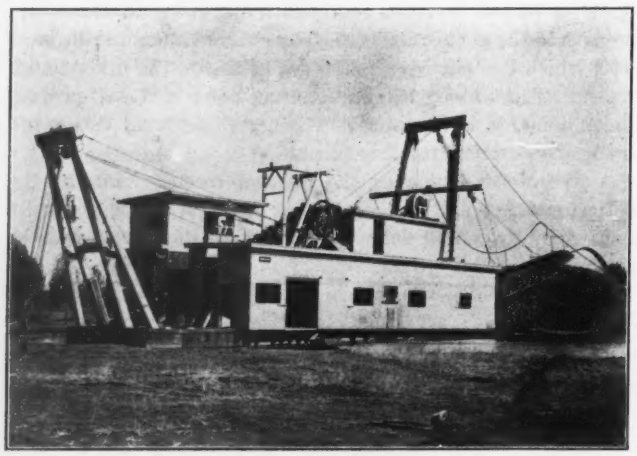


Fig. 1

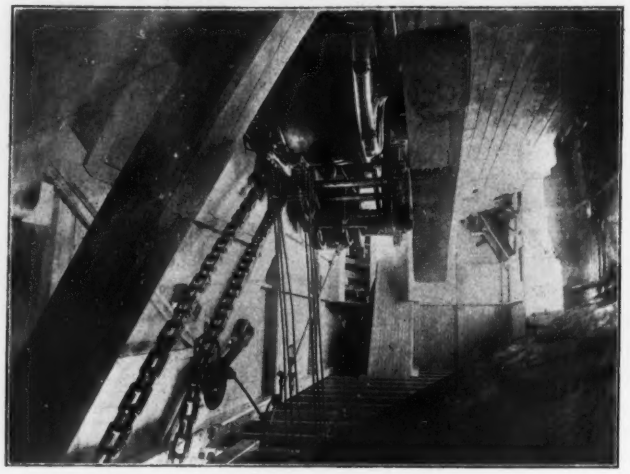


Fig. 2

be re-shipped by steamer to Skagway; it will then be conveyed over the Chilkoot Pass to Caribou, by way of the White Horse railway; carried by teams to Tagish Lake, where it will be re-loaded on a small lake steamer and taken to a landing on the other side of the lake; then transported on a narrow gauge road about six miles to another lake; re-loaded on another steamer to be taken across this lake, and then freighted to Atlin.

Although all of this work has to be done in a very short season owing to the severity of the climate, it is expected that the machinery will be in operation in July of this year, and enough gold recovered during the season to pay the entire cost of the installation, which, including the hydraulic machinery, amounts to over $150,000.

A gold dredge costs from $40,000 to $75,000, depending upon its capacity, and consists of the dredging machine proper and the pumping apparatus which supplies the necessary water for washing and sluicing. The dredge machinery comprises a chain of electrically-driven buckets, which pick up the material, a steel hopper into which the material is emptied, a revolving screen, designed to receive and wash the excavated material, an appliance for carrying off all the coarse tailings and stones that are rejected by the screens, a sluice-box, in which the water and fine material containing the gold are disposed of and in which the gold is saved. The stone chute is of a sufficient height and inclination to discharge the material clear of one side of the boat so that no obstruction can take place on account of the accumulation of tailings. From the under side of the screen all the fine material, including the gold, is discharged with a considerable quantity of water, all of which is carried off and over the stem of the dredge through a sluice-box containing a series of riffles in which the gold is caught, and of a length sufficient to carry the tailings clear of the dredge and to save all the gold. When the gold is of too fine a character to be efficiently collected in the ordinary sluice-box, a finer screen and gold saving tables are employed.

Formerly, the dredging apparatus and pumps were operated by steam engines, and this practice is still largely continued.

Electric power, however, is preferable, since it admits of the operation of dredges where fuel is difficult to obtain, the lighting of the dredge by electricity, and, if necessary, the carrying on of the work at night. An electrically operated dredge is illustrated in Fig. 1, showing at the left groups of incandescent lamps mounted in reflectors. Fig. 2 is an interior view of a dredge, showing a variable-speed Westinghouse induction motor driving a counter-shaft from which the main dredging buckets are operated.

H.

* * *

The Result of Friction in the Indicator

Almost every engineer has a desire to know how to indicate an engine and to know how to read the cards after taking one. This article is not intended for the expert, but rather for the novice, to whom the various line variations are not always quite clear. We cannot pretend to explain them all, but will deal with the vagaries of the pencil caused by friction in the indicator and how to remedy such motions.

Although an indicator, upon inspection, may appear satisfactory in all respects when cold, it may become the reverse of this when in operation and subjected to a high temperature of steam, this application of heat and circumstances causing unequal expansion of the metals of which the indicator cylinder is composed.

The expansion that takes place upon being heated varies in the different parts of the indicator, generally increasing the size of the piston to a greater extent than it does the surrounding metal; and thereby involves a liability of the indicator piston to become sufficiently increased in size as to bind in the cylinder, thus creating excessive friction, but which may obviously be eliminated by a slight reduction in the size of the piston.

Another source of friction which often happens arises from springs of imperfect construction, or out of true, causing, when under tension, a lateral or side pressure against the cylinder.

Either of these faults result in an interrupted or broken action in the movement of the pencil, and which is fatal to the accuracy of the instrument; therefore, in order that perfect freedom of action and that smoothness and accuracy in the pencil movement be attained, it is indispensable that friction in the instrument be reduced to the lowest degree possible.

By the use of this device an amount of interesting and varied information may be obtained pertaining to the condition and action of springs, the variations in pressure for equal movement of the pencil, in showing the difference between a rising and falling pressure when undue friction is present, and also as a means of observing inaccuracies that may appear in any part of the mechanism connected with the indicator.

In many cases errors arise from excessive friction of the indicator piston, caused by scale or grit of any description being carried from the pipes and other connections leading to it.

If such should be suspected it will likely be detected (where slow speeds prevail) either by close observation of the pencil in its movement up and down, or by placing the finger at the top of the indicator piston rod, and gently follow it in its downward movement.

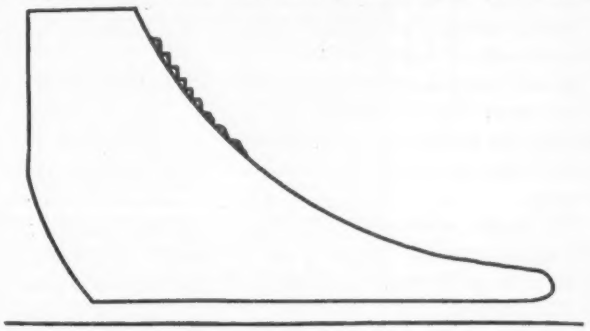
As a matter of course the remedy is to remove the piston and clean.

Sometimes with new indicators and clean pistons an unusual amount of piston friction shows itself in the diagram by a series of very definite serrations on the expansion line just after cut-off, as shown in Fig. 1, the horizontal portion of the serrations indicating a disposition of the piston to hang at each of these positions in its descent.

In some cases of this kind it may be necessary to very slightly reduce the size of the piston by means of a fine crocus paper, or by oiling and allowing it to run a short time, having first disconnected the pencil movement.

With springs of a higher tension, that is, with stronger springs, the serrations resulting from the friction of a tightly-fitting piston will not be so apparent, and will be less defined than with the lighter springs. However, the difference in results on the diagram between a tight piston and one fitting freely will be that with the former the various events of the stroke, such as cut-off, release and compression, will occur later in the stroke, owing to the tardy response of the piston to the variations of steam pressure.

The friction of a tightly-fitting piston, therefore, will cause the initial pressure to be less, but the pressure along the expansion and also the back pressure line (on account



Exaggerated

of its tardiness) will be greater than with the more freely-moving piston.

However, the area of diagrams from each may not differ greatly, because the loss of initial pressure is partially compensated in the formation of the expansion line, owing to a tardy piston.

Occasionally the mean effective pressure in each may not differ materially, still in most diagrams that have been taken with an indicator in which the piston was too tightly fitted, the diagrams have been found to be unreliable, inaccurate and misleading.

The piston friction on an indicator may be approximately determined in the following manner: First, allow the instrument (by a few working strokes) to become heated to a temperature coinciding with the steam pressure present; then, after closing communication with the engine cylinder, gently depress the pencil lever (by hand) just sufficient to slightly extend the spring, and then allow it to slowly return to rest.

While in this position a horizintal line is drawn on the diagram.

The pencil lever is next raised and the spring slightly compressed, and then again allowed to come to rest and another line drawn as before.

The distance or space between the lines so marked is a measure of the sum of the total frictional resistance in both directions, and, assuming the pencil movement without friction, then the whole of the error so measured is attributable to piston friction.

Careful attention to the lubrication of the piston and pencil movements will conduce to smooth running, and, to a certain extent, will prevent the tendency to stick or bind in the cylinder.

Clean cylinder oil will be found a far superior lubricant for the piston than the limpid oil used for the pencil movements.

* * * *

Starting an Ice Machine for the Season

Compression Machines

Each particular type of ice machine has distinctive features which will only appear to the engineer in charge as he comes to know his machine; consequently it is impossible to lay down any arbitrary set of rules suitable to all machines. These rules, however, are more or less applicable to all machines working on the ammonia compression system. At this period of the year we find it necessary to know that our machines are in proper shape to do their work. However, by adhering to the following system of preparatory work we may expect to obtain proper results in operation.

Before charging an empty machine with anhyrous ammonia, all air must first be carefully expelled. This is effected by working the pumps so as to discharge the air through special valves,which are usually provided on the pump dome for that purpose.

The entire system should have been previously to this thoroughly tested by working the compressor, and permitting air to enter at the suction through the special valves provided for that purpose, and it should be perfectly tight at 300 pounds air pressure on the square inch, and should be able to hold that pressure without loss. Whilst testing the system under air pressure it should also be carefully blown through and thoroughly cleansed from all dirt, every trace of moisture being also removed.

It is totally impossible to eject all air from the plant by means of the compressor, therefore it is advisable to insert the requisite charge of ammonia gradually and not all at once, the best practice being to put in from 60 to 70 per cent of the full charge at first, and cautiously permit the air still remaining to escape through the purging cocks with as little loss of gas as possible, subsequently inserting an additional quantity of ammonia once or twice a day, until all the air has been got rid of by displacement, and the complete charge has been introduced.

To charge the machine, the dryer or dehydrator of the apparatus for manufacturing or generating anhydrous ammonia, or where no such apparatus is included in the installation, the drum or iron or steel flask of anhydrous should be connected, through a suitable pipe, to the charging value; the expansio valve must be then closed, and the valve communicating with the dryer or dehydrator, or that in the flask or bottle opened. The machine should be run at a slow speed when sucking ammonia from the drier, or whilst the flask is being emptied, with the discharge and suction valves full open. In the latter case, when one of the said flasks or bottles has been completely emptied it must be removed, the charging valve having been first closed, and another placed in position, until the machine is sufficiently charged to work, when the charing-valve should be finally closed, and the main expansion valve opened and regulated. A glass valve upon the liquid receiver will show when the latter is partially filled, and the pressure gauges, and the gradual cooling of the brine in the refrigerator (in case of a brine circulation or ice-making apparatus), and the expansion pipe leading to the refrigerator coils becoming covered with frost, indicate when a sufficient amount to start working has been inserted.

It is sometimes advisable to slightly warm the vessels or bottles containing the anhydrous ammonia by means of a gas jet, or in some other convenient manner, whilst transferring their contents to the machine, as otherwise if frost forms on the exterior of said bottles they will not be completely discharged, and loss of ammonia will ensue.

The flasks, bottles or other receptacles containing the anhydrous ammonia should be always kept in a tolerably cool and a perfectly safe situation, and they should moreover be moved and handled with the utmost caution and care.

In the event of an accident occurring, and any considerable quantity of the ammonia becoming spilt, it is well to remember that it is so extremely soluble in water that one part of the latter at a temperature of 60° Fahr., will absorb some 800 parts of the ammonia gas, therefore water should be employed to kill or neutralise it, and any person attempting to penetrate an atmosphere saturated with this gas should not fail to place a cloth well saturated with water over his nose and mouth.

The machine having been saturated, and the regulating valves opened, it is essential to note carefully the temperature of the delivery pipe on the compressor, and if it shows a tendency to heat then the said regulating valve must be opened wider; whilst, on the contrary, should it become cold, the said valve must be slightly closed, the regulation or adjustment thereof being continued until the normal temperature of the said pipe is the same as that of the cooling water leaving the condenser. When the charge of ammonia in the machine is insufficient, the said delivery pipe will become heated, and that even when the regulating valve is wide open.

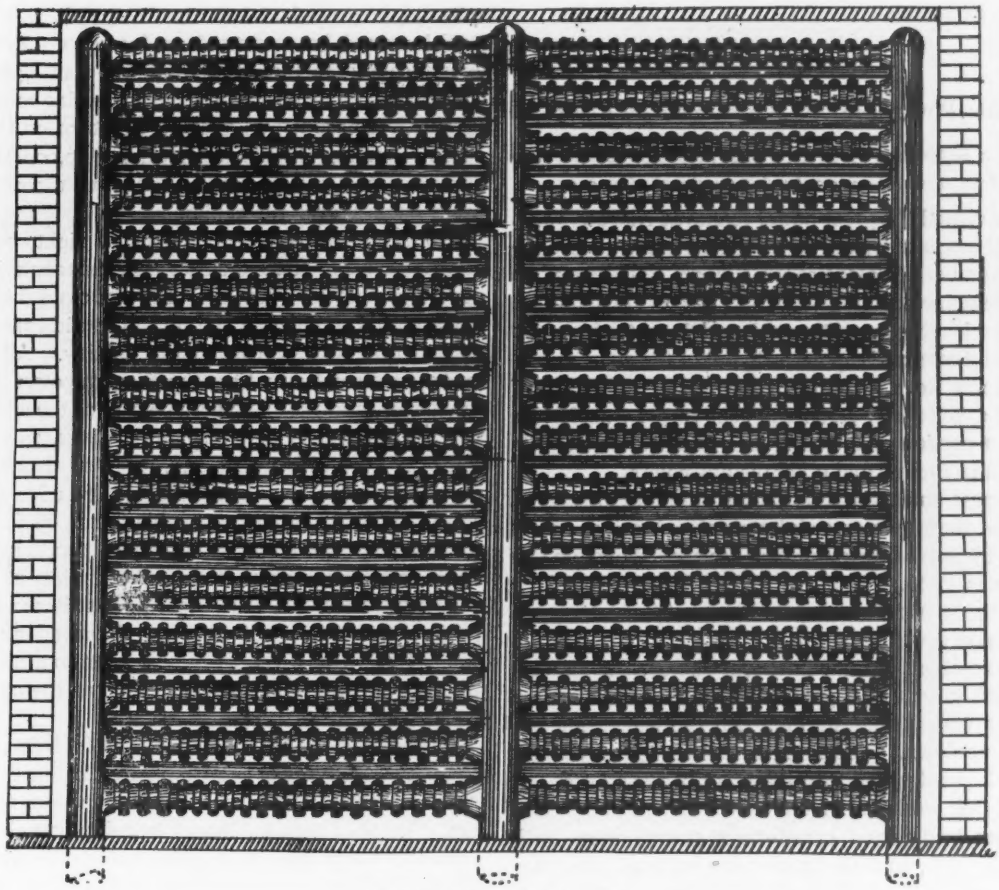
There are many additional signs of the healthy working of the apparatus other than the fact that it is satisfactorily performing its proper refrigerating duty, which soon become easily recognizable to those in charge; for example; every stroke of the piston will be clearly marked by a corresponding vibration of the pointers or indexes of the pressure and vacuum gauges. The frost visible on the exterior of the ammonia pipes leading to and from the refrigerator will be about the same. The liquid ammonia can be distinctly heard passing in a continuous and uninterrupted steam through the regulating valve. The temperature of the condenser will be about 15° higher than that of the cooling water, cooling water running from the overflow. And finally, the temperature of the refrigerator will be about 15° lower than the actual temperature of the brine or water being cooled.

Air will find its way into the system through leaky stuffing-boxes, improper regulation of the expansion valve, &c. Its presence in any considerable volume is shown by a kind of whistling noise, the liquid ammonia passing through the expansion valve in an intermittent manner, a rise of pressure in the condenser, and also loss of efficiency thereof, and other

obvious signs. In this case the said air must be got rid of through the pruging cocks in a similar manner to that which remains in the system when first charging the machine.

The presence of any considerable amount of oil or water in the system, which may result from careless distillation, will cause a reduction in efficiency, and will be evidenced by shocks within the compressor cylinder.

. The temperature can be regulated either by running the machine at higher speed or by increasing the back pressure, or by combination of both. The back pressure can be regulated by means of an expansion valve or valves fitted between the receiver and the refrigerator evaporating coils or pipes in the main liquid pipe.



Showing Radiator set in shaft

The Heating and Ventilating System at Keith's Million Dollar Theatre

Keith's new million dollar theatre, which has recently been opened to the public in Philadelphia, is without question the finest looking house of the kind in America, and in addition to splendor of the exterior parts, the mechanical equipment is such as to delight the eye of any engineer. No expense has been spared to make the entire structure conform to all requirements ensuring the comfort of the patrons of the house. The same thing obtains in the matter of hygienic conditions:-the best methods known to the 20th Century being incorporated in the structure with a view of keeping the air-no matter how crowded the house—free from all noxious gases and in a healthful condition.

The system adopted for heating and cooling the theatre is so unique, yet practical, that it will be of interest to everyone.

Running directly from the roof of the building into a small triangular shaped room is an air shaft. Immediately adjoining this room is a large dome shaped room lined throughout with asbestos and hair felt. Between the large and small rooms is a short shaft about eight foot square. In this square at one end is a huge radiator containing 5000 square feet of heating surface, as shown in figure one, and at the end leading into the chamber is a six foot suction fan. This fan induces a current of fresh air from the roof which passes through the heat radiating coils obtaining a degree of heat subject to the velocity of the fan. The heated pure air is then discharged into the dome from whence leads a myriad of tubes, each ending in small ventilators under the chairs throughout the lower part of the house. These ventilators thus distributing the heat well supplied with oxygen in a uniform manner. The upper part of the house is heated in a like manner with a duplicate system. In order to keep the air in continuous motion there are two fans, of five foot diameter each, in the roof which expel the foul air into the atmosphere as fast as it collects on the inside. Hence no matter how crowded the house, nor what condition of temperature maintains outside, the audience can be assured of comfortable and healthful conditions at all times.

Now we come to the unique feature of this system; as almost everyone knows the Keith Theatre continues open through the summer months. To the average person the thoughts of being in a crowded theatre on a hot summer night is enough to

dispel all idea of going at such a time. But, energy and enterprise, coupled with later day mechanics. make the interior of this theatre in the summer time as pleasant, from a temperature standpoint, as one will find at the seashore. This rather unusual condition is obtained by a complete reversal of the above mentioned method of heating the building. By means of a cold storage plant brine is circulated through the radiating coils shown in Fig. one. A current of air is induced across the radiator, which now radiates cold instead of heat, into the great dome shaped room from whence the air, now thoroughly cold, if distributed in the same manner, and by the same means as was the heat in the winter time. By this method one can readily see that the difficulties and inconveniences of properly heating and cooling buildings in which large crowds assemble are completely overcome.

* * * *

Niagara Falls Power Supply Interrupted by a Fire

Condensed from a paper read by O. E. Dunlap, at the annual meeting of the American Association for the Advancement of Science.

All who have visited the great power plants at Niagara Falls, or know of their magnitude, will be interested in a serious accident which occured at the plant of the Niagara Falls Power Co on Thursday, January 29. Lightning struck and started a fire among the cables leading from Power House No. 1, to the transformer house; on these cables practically all of the current output of Power House No. 1, 50,000 H. P. is carried. The current is generated at a voltage of 2,200 and sent to the transformer station, where a portion of the current is raised to 11,00 volts for transmission to Buffalo and other distant points.

The power house and the transformer station are located on opposite sides of the headrace or inlet canal. A bridge across this canal, and the cables, 52 in number, are carried over on this bridge. At 10.45 P. M., of Jan. 29, the bridge was struck by lightning, and the stroke shortcircuited some of the cables, and set their insulation covering on fire.

Every possible effort was made to put the fire out but the flames succeeded in getting a good start on the bridge and extended into the transformer station. All the generating machines were shut down. The firemen poured great volumes of water into the bridge and into the transformer station, but despite their quick work, all of the cables on the bridge were destroyed. The bridge and transformer station were badly damaged by the fire, and the water thrown into the transformer station wet several of the big transformers, rendering them wholly useless until dried out.

The destruction of the cables cut off the Niagara Power supply of Buffalo, the Tonawandas, Lockport, and the majority of the tenants of the Niagara Falls Power Co. In Buffalo the street lights went out, the trolleys stopped until the international Railways Company's storage battery was thrown in, and the cars on the Niagara Falls-Buffalo line and the Lockport-Buffalo line, as well as in Lockport ceased to run. For an hour or more after the fire the arc lights of Niagara Falls were out and the electric cars stopped. Every customer of the Niagara Falls Power Co., was without power for a short time at least, for until an examination was made after the fire, all current was shut off from both stations (1. e., Power House No. 1 and Power House No. 2, the latter having been only recently completed.) The first service to be restored was that of the Niagara Falls electric railway and the arc lighting system, for this service comes through the rotary converters in Power House No. 1. All patrons of the company who received current that passed over the cables on the bridge were forced to wait until the temporary repairs were made.

The fire was hardly under control before Superintendent Barton was preparing to make repairs. Every man it was possible to put on the job was immediately set to work. Carpenters repaired the roofs of the bridge and the transformer station. The debris of the fire was cleared away. New cables kept on hand by the Company, also some intended for use in Power House No. 2, and some the General Electric Co., had on the ground were brought to the scene, and the electricians of the company hustled them into place. By daylight, Friday splendid progress had been made, and it was expected that Buffalo would be connected up by noon. However, a short circuit caused further trouble and it was 4.30 P. M., before current was flying over the transmission line to relieve Buffalo's distress. Before it was necessary to turn on the street lights Friday evening, Buffalo was receiving 10,000 H. P., and soon afterward the full amount of Niagara Power in Buffalo was again passing over the cables.

From the time of the fire Thursday night, until late Friday afternoon, all of the industrial establishments in Buffalo that use Niagara power were idle. In some cases the men were kept in the plants hoping that the current would come from Niagara, while in other cases the men had a holiday. All of the factories in the Tonawandas that use the Niagara power were also forced to idleness, and the same may be said of the situation in Lockport. In Niagara Falls the majority of the tenants of the power company were without current, but a few that had been receiving power from Power House No. 2, the cables of which did not cross the burned bridge, were able to run on Friday. Some of the idle Niagara factories resumed operations Friday night. Cable connections were established as rapidly as possible. Fortunately for Buffalo, the Niagara Falls Power Co. had several large transformers that were not damaged by fire or by the water thrown into the transformer station, and so these machines were ready for service as soon as the cable connections could be installed.

Considering the extent of the trouble, it is generally agreed that the employees of the Niagara Falls Power Co. performed a wonderful feat in re-establishing connections as quickly as they did. The fact that a January lighning bolt should cause sueh ruin has astonished everybody connected with the Niagara plants. If there had not been a large amount of cable immediately available at the Falls, or if the transformers had all been thoroughly wet, a long delay must have resulted, and the Niagara-Buffalo locality would have been greatly inconvenienced by the lack of Niagara power.

* * * *

A cold storage plant for the purpose of keeping material for use in the dissecting rooms, has been installed in the new medical building at the University of Michigan. The plant contains a direct expansion carbonic anhydride machine.

* * * *

The human system can endure heat of 212 degrees, the boiling point of water, because the skin is a bad conductor, and because the perspiration cools the body. Men have withstood without injury a heat of 300 degrees for several minutes.

Steam Engine Design

BY A. EDWARD RHODES.

CROSS-HEAD.—The length of the cross-head slide should be equal to $\frac{2}{3}$ of the engine stroke. The distance between the guides determines the width of the cross-head, and is found by making a scale drawing with the connecting rod in its extreme position.

For our 12 inches diameter engine:

The breadth of slides may be made .375 x D, or .375 x 12=4½ inches.

The thickness of the slides, if brass, may be .01D + ½ of an inch, or .01 x 12=.12, and .12+.5=.62, or nearly ⅝ of an inch.

When the slides are of cast iron, they should be at least half again as thick.

The cross-head pin may be, .2D= diameter of pin, or .2 x 12=2 4-10 inches diameter.

Its length may be .25D + ½ of an inch, or .25 x .12 + ½=3½ inches long.

This pin should be as near the center of the slides as possible.

The hub to which the piston rod is fastened, may be made two times the diameter of the piston rod.

DESCRIPTION OF DETAILS of half-horse-power engine:

CYLINDER HEAD (A).—The cylinder-head is of cast iron turned all over, and is fastened to the cylinder by five 5-16 of an inch tap-bolts

ECCENTRIC (B).—The eccentric is of cast iron bored to fit the crank-shaft, and fastened to it by a ¼ of an inch set-screw. It is turned to fit the eccentric strap (C), and has a throw of ½ of an inch.

ECCENTRIC STRAP AND ROD (C).—In this case the strap and rod are made of cast brass and in one piece. Drill for the bolts,

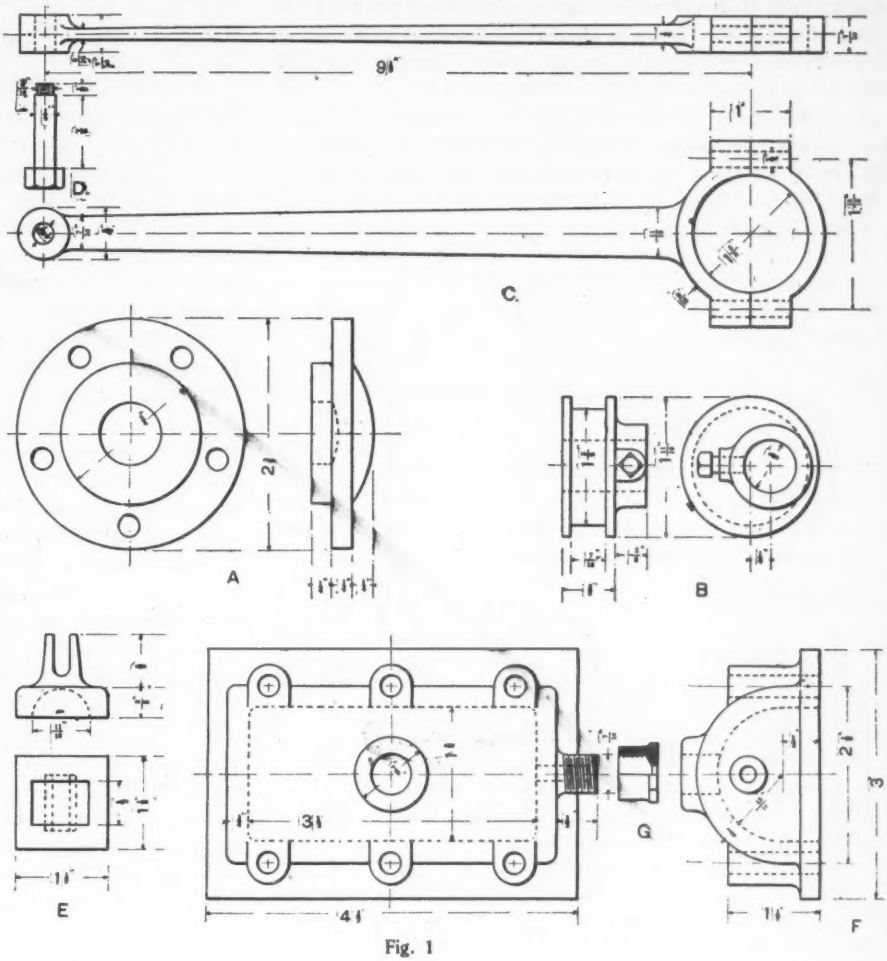


Fig. 1

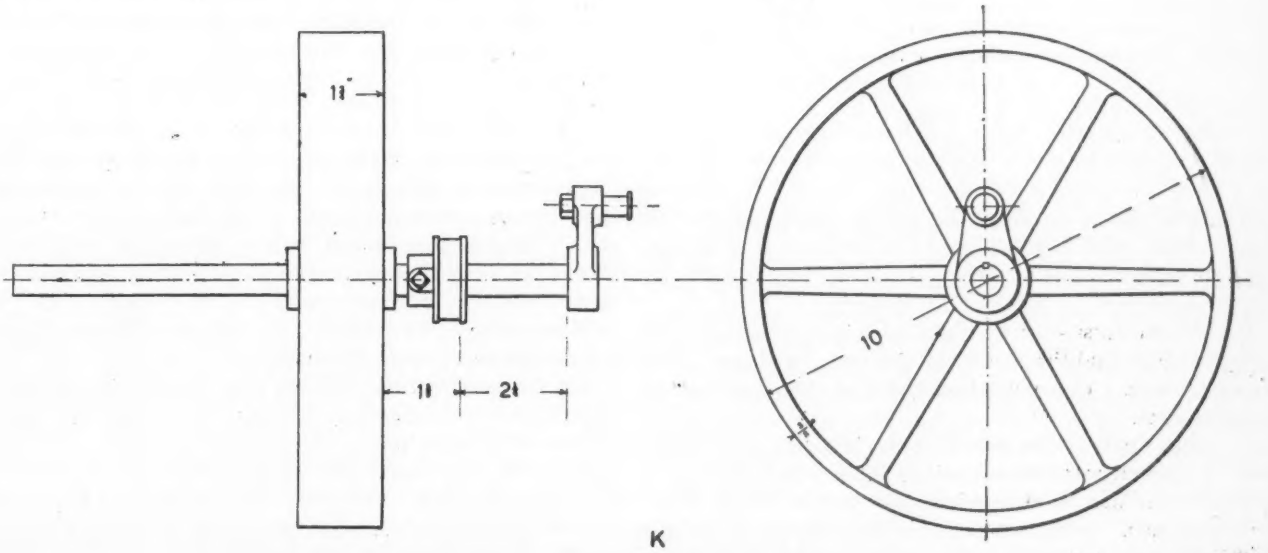


Fig. 2

cut the strap in half. Bolt the two pieces together, and bore to fit the eccentric. Now drill for the rocker-arm pin D. which is made of wrought iron.

SLIDE VALVE (E).—The slide valve is of brass scraped on its face to form a perfect surface on the valve seat.

STEAM CHEST (F).—The steam-chest is of cast iron, it has a 7-8 of an inch diameter projecting lug, which is tapped for a $\frac{3}{8}$ of an inch steam pipe. The valve stem stuffing-box is made by an externally threaded lug $\frac{1}{2}$ of an inch long. The gland for this stuffing-box is made of brass, and is shown at (G).

CROSS-HEAD (H).—The cross-head is a rectangular shaped piece of cast-iron tapped at one end to receive the piston rod, and cored at the other end to receive the connecting rod.

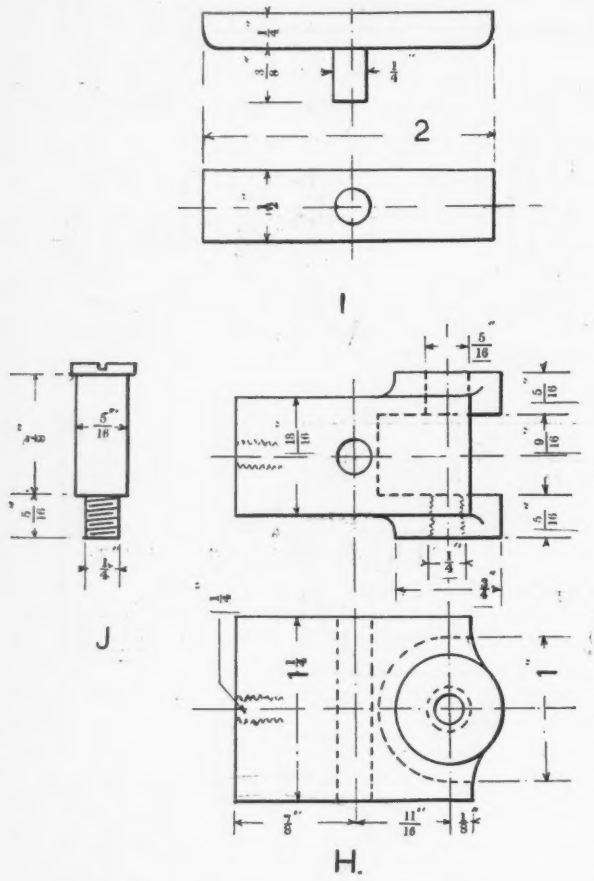


Fig. 3

The outside boss for the cross-head pin (J) is drilled 5-16 of an inch, and the inside boss is tapped $\frac{1}{4}$ of an inch. $\frac{7}{8}$ of an inch from the cylinder end a hole $\frac{1}{4}$ of an inch diameter is drilled to fit the projecting lugs on the brass slides(I).

FLY-WHEEL (K).—The fly-wheel is 10 inches diameter and set-screwed to the crank-shaft in the position shown. The eccentric is set $\frac{1}{4}$ of a revolution ahead of the crank and $2\frac{1}{4}$ inches from it.

CYLINDER COVER.—The cylinder cover is simply an L shaped piece of cast iron or cast brass made to fit the cylinder flanges.

BASE.—The base is of cast-iron of a general thickness of 3-16 of an inch. In making the drawing be careful to provide raised planing places to give a true surface for the main frame and pedestal, also provide a hole for that part of the fly-wheel which is below the base of the main frame. Make the outline as shown in the photographs Part I, and at least $\frac{1}{2}$ of an inch larger all around than is absolutely required by the feet on the main frame and pedestal.

* * * *

The Thermophone

An interesting as well as useful instrument, which among its various applications includes the field of refrigeration, is the Thermophone. There is something fascinating about it to one who understands enough about electricity to grasp the ideas involved in the telephone and the change of resistance of an electrical conductor with a change of temperature. To one who does not comprehend these, the deeper the mystery, the greater the wonder and admiration. Just think of determining the temperature by the ear. What then is the thermophone?

The thermophone is an electrical thermometer of ther esistance type. It is especially valuable in determining the temperature of a distant or inacessible place. It was devised for the purpose of obtaining the temperature of the water at different depths in a reservoir. It was so successful in operation that its inventors were encouraged to study further into the capabilities of the instrument with a view of adopting it to scientific and commercial work.

Many resistance methods for the determination of temperature have been used, all depending upon the principle that the resistance of a conductor to the electrical current varies with its temperature. It is readily seen that any apparatus capable of measuring the resistance of the material may also be used to measure its temperature, as one is the function of the other. In the instrument under consideration, advantage has been taken of the fact that different metals have different electrical temperature co-efficients.

Two resistance or temperature coils of different metals, such as copper and german silver, are placed side by side to be under the same conditions of temperature. The outer ends of these coils are connected by leading wire to the terminals of a slide wire where connections with the slide wire are made. From the junction of the inner ends a third wire is carried to a movable contact on the slide wire. This third wire has in its circuit a galvanometer or a telephone used in connection with a current interrupter, operated by an independent battery supply, for the purpose of indicating the presence of a current. Ths whole is the form of a Wheatstone bridge, aud the sliding contact is moved in the proper direction to balance the changing resistances of the bridge coils. For each degree of temperature there will be a different position of the slider, and by a proper calibration a graduated scale will be made. In practice the slide wire is wound around the periphery of a disk, the upper surface of which is graduated in degrees of temperature. The slide presses against the slide wire, and the movable index shows the temperature of the distant coils.

The temperature coils and third wire, properly insulated, are inclosed in a thin brass tube, strongly and hermetically sealed to withstand water pressure or careless handling. The brass tube may be left straight or wound in a spiral as desired, the coils are made usually with leads nine feet long, but these leads may be connected with a triple cable of any length, so that they may be carried to any position desired.

It will be seen that the temperature of the leading wires will have no effect, as they are placed side by side and subject to the same changes, and one tends to influence the reading of the instrument in one direction as much as the other wire in the opposite direction. The temperature of the slide wire will have no effect upon the reading of the instrument, for being one piece of metal which has the same temperature throughout its length, each portion of it will rise and fall in resistance at the same rate with changes in temperature, consequently the ratio of its parts will not change. The operation of taking a thermophone reading is as follows:—The coils are placed at the spot the temperature of which is desired, and the three leading wires are connected with the proper pole coils on the indicator box. The switch is turned to connect the battery, and the hand telephone is held to the ear, the index is moved back and forth over the dial. A buzzing sound will be heard in the telephone, increasing or diminishing as the index approaches or recedes from a certain section of the dial. A point will be found at which there is perfect silence in the telephone, and at that point the hand will indicate the temperature of the distant coils.

The coils must of course be located at the point whose temperature is to be determined. As the same is not the case in regard to the other parts of the apparatus, these may be located at any convenient point. There follows, in consequence, an interesting feature of the apparatus, namely:—that by having any number of coils located at different points and a suitable switching device for switching the indicator to any of them as desired, one indicator only is needed; in short, the apparatus may be so installed that a man may without leaving his office find the temperature of any room of his factory or hotel or public building.

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The Simplicity of the Dynamo

The whole thing may be compared, in its principles, to the working of a steam pump forcing water through a line of pipe of the same extent as the line wires. The dynamo (or pump) forces electricity instead of water. So long as the dynamo or pump works continuously the pipes or wires are filled with a current of water, or electricity, flowing in one direction; in other words, a continuous current. Thus, we may say that a certain number of pounds steam pressure is required to overcome the friction of the water in the pipes, so that so many cubic feet or gallons of water shall be delivered per minute; equally true we can say, so many volts are required to overcome the resistance of the wire, so that the current shall be delivered in so many amperes per minute. Hence, to simplify, we may say pounds of steam pressure = volts; the friction = resistance; the pipe = the wire; current = volume of water in motion, and amperes of electricity = gallons of water delivered at the end per minute. Every engineer knows that the larger the pipe the more gallons water per minute, and the less relative friction, so the larger the wire the more current can be carried and the less the resistance, relative to the number amperes delivered. The same analogy holds good in the opposite, for the smaller the pipe or wire, the greater the friction, or resistance. Every engineer who uses a steam pump or an injector knows that there is some point to which, if his pipes were reduced in size, nearly or quite all his power (steam pressure) would be absorbed in friction. So electrically our voltage may be largely consumed or absorbed by too small a wire; in either case—either the water or the electricity—the result of the work done is in both cases uniform and identical, viz.: A continuous current, and is the current that has been generally used for the production of light and power. The other current, which is largely employed in the generation of electrical power, viz.: the alternating current, differs essentially from that which we have described above, and in fact our analogy to the working of a pump comes to an end. The current from an alternating dynamo, instead of flowing continuously and directly, is simply a vibratory movement or a "back-and-forth flow." Here the supremacy of electricity as a power comes in, for, returning to one pump, should we at each alternate stroke of the pump reverse the direction of flow of the water, the entire power, or nearly all of it, would be absorbed by its weight, and the friction in the pipes. But electricity being without weight, there is of course no loss by reversing its flow; indeed, the possibilities of application to useful service, dependent on the reversals, are of the greatest value. To clearly explain the action of the alternating system, we have to consider the requirements under which electricity does its most acceptable work.

Every engineer who is making electric lights knows that the most satisfactory results, that is, the best light, is obtained by using a dynamo and distributing system of as high voltage as possible, in conjunction with a lamp of low voltage. Here, then, we have two actually opposite conditions, which must be harmonized to produce a perfect result in their action, and which are plainly impossible in the continuous-current system, which we have explained by the comparison to our pump, because it is evident, to renew the comparison, that if we are carrying a pressure (steam), and our line of pipes is calculated to deliver a certain amount of water per minute, if we throttle down at the delivery end, so as to deliver only 1-10 or 1-20 of the amount, we shall only be able to do so by reducing our pressure relatively, involving a great loss of efficiency, or incur the risk of destruction to the plant at some time.

Hence we are obliged to provide some appliance which shall intervene to convert the high voltage of the dynamo and circuit to the low voltage of the lamps. When such an appliance is used it is known as a converter system, and the use of an alternating current and converter system are mutually dependent on and necessary to each other.

This system can be compared to the engineer's system of steam heating in his building thus: Suppose he carries 75 pounds boiler pressure, and the steam is carried into the building in one main pipe, and from that is distributed by risers, etc., to the different radiators in the building. It is evident that he has no use for full boiler pressure on the risers and radiators, as, even if they would stand it for a time, it would be no more effective for heating than a reduced pressure; hence he puts in a reducing valve in the steam main, between the boilers and risers.

So, then, the converter used in connection with an alternating current is exactly an electrical reducing valve, with a high pressure (voltage) on one side and a low working pressure (voltage) on the other. Thus, by using this converter, he may carry any voltage at the dynamo and primary circuit, reducing into the secondary, to conform to the amount of current required. Each current, continuous or alternate, have special fields to which they are adapted, and while both are extensively in use, each has its peculiar adaptation.

The Practical Engineer

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The Engineering Building at the University of Michigan

That education is fast becoming a leading factor in the profession of steam engineering, is evidenced by the position taken on the subject by our principal schools and universities. It is quite possible that no other line of business has had the same accessions and new departures added to it; hence the necessity for more than the ordinary advancement such as maintains in any of the other trades or professions.

Generally, natural evolution of the times keeps a man well to the front. But, the application of power being the foot-stone of our commercial success, naturally the engineer's requirements have increased more in volume than in any other branch of business. That this need is recognized and appreciated by the general public is proved by the fact that almost every college or university of note in this country have added to their courses a department of Steam Engineering and Electrical study.

The University of Michigan is just now completing an engineering building at a cost of $140,000. Among the more important features of the building and its equipment will be a naval testing tank, the compressed air room, the hydraulic labratory, the cold storage department, steam engine room, and electric rooms.

A tank for testing ship models which is nearly completed is in the basement of the north wing. It is 300 feet long, 22 feet wide, and 10 feet deep. Connected with it is a dry dock capable of holding a model 10 feet long. This tank will be used for experiments concerning the shapes and sizes of boats, and the different kinds of propellers. In the compressed air room there will be machines capable of delivering air at the various pressures up to three thousand pounds per square inch.

The cold storage department, will consist of the ice machine, and three cold storage chambers with cooling coils. With this department it will be possible to test building materials which have been subjected to low temperatures.

In that portion of the building given over to steam engines there will be a special multiple expansion engine, with cylinders arranged so as to secure a great variety of expansions. There will also be machines representing the different types of engines, including the steam turbine.

Besides the above there will be rooms for testing instruments, computing, calibrating, drawing, recitation rooms, and instructors rooms. With such equipment for practical experience and the additional advantage of proper tutors the holder of a diploma from the University of Michigan will command a position in the ranks of the engineering field second to none.

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Inventions and Reports of Inventions

Unless predictions fail the ending of the 20th Century will probably see a utopian condition prevailing throughout the world far beyond the pale of our forefathers most vivid imaginations. The aforesaid predictions, if fulfilled, promising untold additions to mans comfort and pleasure—rich and poor alike. First we have a report from "Tesla" in which he states that he will soon place on the market a system of moving cars, automobiles and etc., by wireless application of electricity. In other words he means to transmit power from a central station to any place, or to any movable car by means of the wireless system. However, he does not state just how soon he will accomplish this result.

Edison announces in specific terms that he has perfected his storage battery and that the days of the horse are numbered. These are his words:

"The new battery will settle the horse—not at once, but by degrees. The price of automobiles will be reduced so that almost every family may have one and run it with out the aid of an expert. In fact, I hope that the time has nearly arrived when every man may not only have his own automobile, but also be able to light his own house, charge his own machine, heat his rooms, cook his food, etc., by electricity, without depending on any one else for these services."

That seems an audacious prediction, but Edison is not in the habit of boasting idly of his achievements, and the invention of a storage battery adapted to vehicle trac-

tion does not appear half so wonderful as many other things he has done.

But, we have a report, emanating from somewhere in Massachusetts, in which a man claims to have found means of making fuel, for any purpose of plain ordinary water. This out Teslas' Tesla and certainly places more strain upon our credence. Even Edison must look to his laurels lest this water fuel man wrest them away from him. Banishment of the horse from city streets would be a small matter compared with the rescue of the world from all danger of fuel famine and the instant collapse of the Coal Trust. If the water-burner will only make haste to put his device on the market, the family automobile can wait awhile.

But alas we are afraid the water burner will find it much easier to talk than to produce the goods; hence the firemen may still rely on having to use the shovel and slice bar for awhile yet.

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Shall the Law or the Railways Govern the Extent of Human Fallibility?

At different times "The Practical Engineer" has taken a stand for a betterment of the conditions of both locomotive and stationary engineers. The absolute dependence of the safety and lives of power plant inmates, and railway travellers, upon the sureness of the eye, and clear action of the engineer's brain, is too often manifested by serious results to be passed over lightly. We have illustrations of this in two terrible railway disasters occurring about a month since, one on the Central Railway of New Jersey, the other on the Southern Pacific not far from Tucson, Arizona. In each case a score or more of lives were lost, and each collision was attributed to criminal negligence of a railway employee. In Arizona a station agent failed to deliver an order to the engineer—the result was two trains met head on; in New Jersey the engineer of a fast express passed several cautionary signals and one peremptory signal, and paid the penalty with his life when his engine crashed into the rear of a train which had stopped on account of a hot box.

It is not enough, however, when we read the pitiful and heart-renderng accounts of the suffering that followed the collision, to say that human error is inevitable; we may properly ask whether this very element of fallibility has been guarded against up to the possible limit. In the Westfield collision, for instance, the railroad has an excellent block system, the signals were properly set, an extra precaution had been taken by telegraphing a special stop order, which either was not signalled or was not noticed by the engineer, probably the latter; In the eyes of the public and according to law the engineer, Davis was plainly and flagrantly to blame. Yet the circumstances show that, with all the rules observed, the margin of safety for fast expresses on that road is a very slender one. The engineer was alone in the cab, the fireman ten feet away from the cab, and not where he could communicate with the engineer; the latter suddenly found the injector out of order, turned to fix it, and in two minutes the engine, rushing on at a speed of perhaps seventy miles an hour, had covered more than two miles, passed several signals, and was close upon the preceding train. Ought not there to be a law to require more than one man to be in the cab of an express train? An attack of illness, an accident, any one of a dozen causes, may at any moment incapacitate an engineer; and on all the new type of locomotive in use on the Central of New Jersey the fireman is most of the time where he can be of no assistance. Again it is asserted that Davis declared before his death that it was the general custom of engineers to run past the green cautionary signal and up to the redstop signal without slacking speed, in the belief that the stop signal would change by the time it was reached; that he relied on the track being kept clear for the express, as was usually done; and that no fast express could make time if the engineer obeyed the rules strictly. All these things may be false, but the public has a right to know how closely railway companies are enforcing their own rules; to know if it is true that an engineer is impelled to risk his own life and those of his passengers in order to make time, and that he can take such a risk without being punished (to pass a red block-signal light knowingly is a penal offense,) whereas a failure to make time injures him. If these things are so, then any block system that can be devised is worthless, and the wonder is, not that calamities take place, but that so few are recorded. There should be a constant inspection of the actual working of railroads by state officials acting for the public safety and with power to prosecute individual offenders.

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Practical Ideas from Practical Men

It is now one year since we introduced the "Engineer's Letters" column into our paper, and during that time we have received many letters from our engineer friends containing ideas valuable to any one engaged in the engineering profession. It is the intention to have this feature of our publication made its most interesting and strongest point—in short we want "The Practical Engineer" to be practical in fact as well as in name; and it is to this end that we urge our readers to send in to us any of the many ideas which daily occur to them in the actual practice of their profession.

One man alone cannot assimilate in the brain what one hundred men can; yet if we extract the essence from the hundred, properly compiled, it may readily be comprehended by each and all. It is to this end that we originated the "Engineer's Letters" column. Let everyone send in an item of interest and in this manner our paper will become a compilation of practical experiences. It is not necessary that the articles be particularly well written or that the drawings be perfect—it is simply the idea we want- We will always be pleased to place it in present able form and will pay the writer a price commensurate with the value of the article.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

The Benefit of Licensing Engineers

Editor PRACTICAL ENGINEER:

Notwithstanding the vast deal that has been said and written on the necessity for efficient license laws enforced on the steam-engineering profession, we find large districts in which there is no adequate law requiring a systematic and thorough examination in practical and scientific steam-engineering of those in charge of the steam-power plant.

Such a measure has often been very blindly opposed by some engineers (in name only) and many owners of power generating plants.

It shall be the purpose of this short article to present in as concise a manner as possible, some of the many benefits secured mutually to the employer, employee and the engineer in procuring the services of the most proficient engineer obtainable and is consistent with the demands of the position to be filled. This is a condition of affairs to be more largely secured by the protection of effective license law than through any other medium.

In the first place you could scarcely mention a plant in which the competent engineer would not effect a saving, in point of economy, of several times the difference between his salary and that of the third or fourth-rate engineer so commonly met with in sections that submit to their depredations; a matter which would astonish an employer who has not given attention to such details.

There we would call attention to the increased output due to the higher degree of efficiency of the machinery and appliances under charge, a matter that is difficult to estimate but one that is seldom over-estimated. To this you may add double, and, in many cases, more to the life of the plant as compared with the management of the incompetent man; and before you close the account place in the proper column the difference in repair bills and the losses arising from shut-downs. Let the employer make the figures and look at them for himself. These are facts that present themselves if only observed, and are worth their weight in gold, for to the owner it means gold.

To the laboring employee it affords a degree of security to life and limb that is never present when the incompetent man is in charge at the most responsible post on the entire premises. Power plant disasters seldom end with simple injury to property and those immediately in charge of it, but often effects many that are in no wise answerable for its management; you must consider, too, that in many cases the undeserving man demands and receives as handsome a salary as the first class mechanic.

Price is not the only qualification for the engineer, nor is it altogether a "good talk." The engineer only can measure the qualifications of the engineer and to him only can the employer as well as the craftsmen look for protection against the imposter, and no engineer who is worthy to be called "engineer" will by neglect or unworthy motives betray that trust when confided to him by his mutual friends both in and out of his honorable calling.

Such a condition will secure the true engineer against unscrupulous competition and establishes a higher degree of respect for his calling in the outside world. It gives a growth in its own disciples to a pride that will stimulate progress and a higher degree of culture that otherwise will never be aspired to. It effectually places the mark of distinction between the pretender and the engineer.

We hope that such a state of affairs as this may soon exist throughout the country. Then and not until then will the standard of steam-engineering be elevated to the plane which it deserves to occupy.

D.A. G.

Lead Packing Rings

Editor PRACTICAL ENGINEER:

I herewith give you an idea which I found of great value to me, and which may be of interest to many of your readers. Some time ago I had charge of a Corliss engine on which the valve stem and piston rods were very much worn; in fact I could not keep them from leaking no matter what packing I used.

After giving the matter considerable thought I finally decided to try packing rings of lead. These rings I made to fit close to the stuffing box and also the rods. I placed one of the rings into the bottom of each stuffing box and then followed them with soft packing. This I found to be an effectual remedy for any trouble.

About the best way to make these rings is to get a piece of board 6 inches square, 1 inch thick and another same size but $\frac{1}{2}$ inch thick, and bore a hole in the $\frac{1}{2}$ inch board, $\frac{1}{8}$ inch larger than the stuffing box which the ring is for, so as to allow for trimming; nail the $\frac{1}{2}$ inch board on the 1 inch piece.

Get a piece of pipe or shaft same size as the rod for which the ring is to be made, then place this in the centre of the hole and pour the lead around this. After the ring has cooled off, take it out and finish it with a rasp to a good tight jib for the stuffing box and rod.

Some stuffing boxes have bevel bottoms; to make rings for these take out the old bottom packing ring and make a mould out of plaster paris.

H. JAHUKE.

The Nerst Lamp in the Farmer's National Bank, Pittsburg, Pa.

The Farmer's National Bank Building, which is to be the largest structure in Pittsburg and one of the tallest offices buildings in the world, is nearing comp letion and will be oc cupied early in March. Contracts for the electrical apparatus have been signed and most of the apparatus is already in place. The generating plant, consisting of three 150 K. W. and one 75 K. W., machines has been furnished by the Westinghouse Electric & Mfg., Company and the building has been wired by Clark & McNollen, of New York.

The lighting contract was the most hotly contested of any in the building and the outcome is that the entire building is to

be lighted with Nernst lamps made by the Nernst Lamp Company, of Pittsburg, and supplied by the Doubleday-Hill Electric Company of the same city.

Alden and Harlow, the architects for the building, decided on the Nernst lamp because of the beautiful quality and steadiness of the light, the absence of shadow and the high efficiency. There are to be installed 1000 55-watt single glower, 1250 88-Watt single glower, 20 two-glower and 20 six-glower lamps, and although different units will prevail in the building, the quality of light will be the same throughout, this being one of the features of Nernst Lamp illumination in distinction from the combination of arc and incandescent lights ordinarily found in large interiors.

The fact that this immense building has been equipped with alternating current apparatus for the sole purpose of making the Nernst lamp available constitutes a high tribute to the new illuminant and is an indication of the rapid strides which the Nernst lamp is making in the electric lighting field. The Nernst Lamp Company is certainly to be congratulated upon its success.

Manzell's Automatic Positive Lubricator Pump

The high speed of modern engines and other machinery has necessitated the adoption of some form of positive supply of lubrication, so that so long as the oil container is properly filled with oil or similar lubricant, the process of distribution will be carried out without any practical chance of failure or want of uniformity of supply to the various parts that require constant lubrication during the working of the engine or machine. This difficulty has been met by the adoption of forcing appliances—such as pumps—which deliver the lubricant under pressure to the necessary parts.

Although the principle is old, devices having the same end in view, but with the object of better or more simple working, are brought out and put on the market from time to time. We

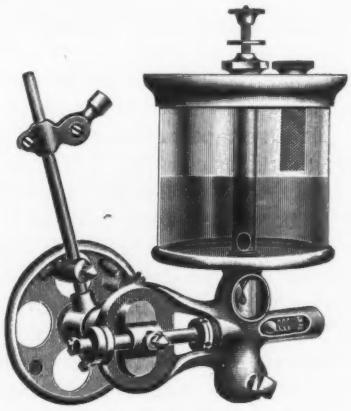


Fig. 1

have now the pleasure of describing and illustrating one of the latest type, which, quite apart from its simple construction, appears to have certain merits that of themselves should tend to create some interest in the minds of those interested in the subject.

Fig. 1 of the adjoining diagrams shows a single feed-pump, from which it will be seen that the pump is situated at the lower part of the device, the driving mechanism consisting of a lever adapted to oscillate about an axis, and provided with means for coupling it to any reciprocating mechanism; a rotary device driven by the lever through a clutch action, and a disc crank and a slotted cross-head on the pump plunger driven by the crank. A sight-feed tube is fitted in the suction pipe, by which the rate of feed can be visually ascertained. The pump is surmounted by an oil reservoir made of glass, within which is fitted the suction pipe from the pump, to which is fitted a regulating valve provided with screw adjustment and lock-nut situated on the top of the reservoir cover by which the supply of oil can be regulated. Fig. 2 shows a triple sight-feed arrangement, the crank-pin driving through a cross-head

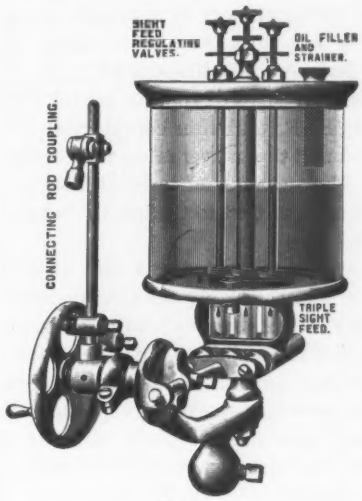


Fig. 2

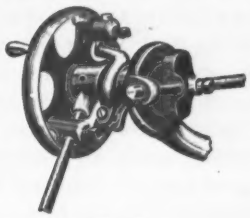


Fig. 3

three separate plungers in independent pumps. It will be seen that each pump has a separate regulating valve and separate sight-feed tube, so that three parts can be lubricated with a variable and independent supply of lubricant.

Each of the oil reservoirs is provided with a filter or strainer at the filling orifice so that the purity of the lubricant in the reservoir can be ensured.

One of the most interesting features of the device is the clutch arrangement of the driving mechanism, details of which are illustrated in Fig. 3. This arrangement consists of a drop forged steel wheel rigidly mounted on the rotary shaft, and having a groove on the inner edge of its rim, in which engages a ball carried by a clutch block mounted on the operating lever. The ball is held in position on a wedge seat in the clutch block by a spiral spring. A ball brake or retaining device of a similar construction is fixedly mounted on the pump to maintain the crank shaft stationary on the return stroke of the operating lever. It will thus be seen that the wheel can only revolve in one direction and that through the medium of the ball clutch, which acts in a similar manner to a ratchet and pawl arrangement. The angle of movement of the operating lever, can be varied by altering the position of the coupling device relative to the axis of movement.

The device is noiseless in operation, and starts and stops with the engine. The oil reservoir and sight tube are not under pressure, and being free from steam or water are perfectly clear and unobscured by vapor. If a momentary flush of oil is necessary, such as at starting, this can be readily given by turning the wheel by hand without disturbing the adjustment of mechanism in any way.

The pumps are manufactured by Manzel Bros., Buffalo, N. Y. The leading American and British Engine Builders have adopted these pumps. The manufacturers will be pleased to furnish further information.

A Device for Measuring Power

To power lessors the following article will appeal strongly, and to those engineers who find their 100 horse-power engine inadequate to supply power to tenants who are only paying for 75 horse power, it will appear too good to be true.

However, that necessity is the mother of invention, has been proved true by Mr. Robert Wick, of 636 W. 30th Street, New York. Mr. Wick is the inventor of the power controlling device described herein. The circumstances of its origin is as follows: Mr. Wick leased a loft to a tenant to whom he agreed to furnish power by shafting to the amount of 15 H. P. As time went on Mr. Wick became satisfied that his tenant was using nearer 30 H. P. than 15 H. P., and after considerable argument the power was shut off and the matter taken into court. The judge decided that Mr. Wick was bound to furnish the 15 H. P. anyway, and if he sent more of that to the loft the tenant was not to blame for using it.

This decision made it necessary to overcome a difficulty of this kind in a mechanical way and the result was the invention of the Wick Power Controlling Device, by which a line of shaft ing can be controlled so that it is impossible to use only a stipulated amount of power and if that amount is exceeded, first an alarm is given and then the power is automatically shut off These devices are built in any size and are likely to prove a great boom to those who rent buildings with power furnished to tenants. The device is described as follows:

The combination with a driven shaft, and a clutch member nfixed thereon, of a driving member independent of the clutc member on the shaft and adjaccent thereto, an extensible connection between the two clutch members, permanently secured to one of them, means on the other member for holding said extensible connection, a latch for locking said means in place, and means on the member to which the extensible connetions ois pemanently attached for tripping said latch, substantially a set forth.

The Combination with a driven shaft, and a clutch member fixed thereon, of a driving clutch member independent of the clutch member of the shaft and adjacent thereto, a spring attached to the driven member, a lever pivoted on the driving member and having means for engaging the free end of said spring, a latch pivoted on the driving clutch member and engaging the free end of said lever, and a tripping-pin on the driven clutch member, part of the latch on the driving clutch member extending into the path of said pin, substantially as set forth.

The combination with a driven shaft, and a clutch member fixed thereon, of a driving clutch member independent of the clutch member of the shaft and adjacent thereto, an extensible spring having one end secured to the driven clutch member and provided at its free end with an eye, a lever pivoted on the driving clutch member and provided at its pivoted end with a toe adapted to enter the eye of said extensible spring, a latch pivoted on the driving clutch member and a pin on the driven clutch member for tripping said latch, substantially as set forth.

The combination with a driven shaft, and a clutch member fixed thereon, of a driving clutch member independent of the clutch member on the shaft and adjacent thereto, an extensible spring attached at one end to the driven clutch member, and having one end free, a lever pivoted to the driving clutch member and having a toe at its pivoted end for engaging the free end of the extensible spring, a spring pressing said lever against a stop, a latch engaging the swinging end of the said lever and pivoted to the driving clutch member, a spring acting on said latch and a pin on the driven clutch member for tripping said latch, substantially as set forth.

The Degree of Efficiency of Pipe Coverings

T. Duncan Just.

To properly deflect radiation of heat from steam pipes has long been a complex question, for, while there are many manufacturers of pipe coverings wooing the market for trade, yet withal the question settles on two points alone; first: What constitutes the best non-conductor, or deflector? Second: Can it be practically applied? To science the best known non-conductor of either heat or cold is dead air cells—meaning air without a possible movement or circulation. Now we find that hair, being composed of myriads of air cells, when compressed, presents more of these dead air cells in a given area than any other article known to commercial use. But hair felt, as it is usually termed, cannot be used in an unadulterated state where it comes in contact with heated surfaces, because the great amount of oleoginous substance contained therein is directly affected by heat, hence, there is a rapid deterioration of its beneficial qualities. To overcome this condition, however, there are numberless compositions of hair, and almost any material not readily affected by heat. These are moulded, or otherwise formed, into pipe coverings, all containing a degree of efficiency depending upon the percentage of hair contained therein, the material used of course, being subject to a more rapid deterioration as the point of efficiency increases.

This condition maintains where heat comes in contact with the composition, as it certainly must when made into steam-pipe jackets.

As a lining for cold storage plants, or similar conditions, hair is unexcelled, but in its pure state, the expense places it beyond all competition in this line also. We are thus compelled to look for the next best article commercially obtainable. It must be borne in mind, in making our choice, that we must have an article which will remain unaffected by any degree of heat radiating from steam pipes under the highest pressures, and also an article which will likewise be unaffected by the dampness of cold storage plants. It may appear strange to the average person when we mention cork for covering either hot or cold pipes, yet a careful study of the following facts will convince the most skeptical, be he unprejudiced, that such is the case.

First. Cork is composed of numberless air cells each encased in a fibre so compact as to preclude any connection each with the other; herein we have then a non-conductor and of a tested value second to hair alone. Second. We know that cork will amalgamate under pressure without the use of other ingredients, or adulterations, thus we lose none of its efficiency in conforming it to any style of pipe or fitting—it must be remembered that the introduction of foreign material to aid its amalgamation would necessarily reduce the efficiency. Third. And paramount to all other methods of pipe covering of like efficiency is the practically indestructible nature of cork under any degree of heat possible to reach it through contact with steam pipes.

Summing up these known conditions we find then in cork an excellent steam pipe covering as it also is the ideal cold storage insulator. Because of its lightness we have no appreciable strain upon our pipe. Because of its not being affected by dampness

or moisture we have no fear of disintegration from that source. Because of its efficiency combined with its powers of withstanding heat successfully we have a heat deflector which cannot be approached either in the matter of expense or length of practical service.

A long mooted question has been "will cork safely withstand heat?" This question has heretofore been a stumblng block to the almost universal adoption of the article for steam pipe jackets, despite the fact that many, and varied tests proved its heat resisting qualities to be of a high degree. A conclusive proof of its lasting qualities under severe heat is amply demonstrated by the accompanying engraving. This picture was taken immediately following a fire which completely destroyed the plant of the Nonpareil Cork Co., Camden, N. J. This concern are manufacturers of cork pipe coverings of every description, and also cork insulation for cold storage plants. A careful study of the cut will show that where once stood the framework of the building, nothing remains but ashes and twisted and torn iron work. Yet numerous blocks of prepared cork were stored in the very midst of the fire and remained practically intact except for the slight charring of the edges, as will be readily observed. This action of cork in resisting such intense heat certainly demonstrates that, the heretofore, only possible objection to its use is a fallacy, no other known substance of like efficiency being capable of successfully withstanding such severe tests. The manufacturers have since rebuilt the burned plant, shown above, but have saved a great portion of the charred blocks that they may be examined by anyone interested in such matters. By addressing John R. Livezey, 1936 Sansom Street, Philadelphia, or the Nonpareil Cork Mfg. Co., Camden, N. J., a portion of a charred block will be sent to college professors or anyone interested in the study of such matters, in order that they may personally observe the effect the highest temperatures have upon cork.

Everything burned but the cork

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Editor PRACTICAL ENGINEER:

Will you please tell me the rule to find the distance to put the weight on a lever safety valve, and oblige,

VALENTINE DUTTON.

To get the length of the lever of a safety valve take the total pressure on the valve and multiply the distance in inches from center of stud to centre of valve stem; now divide this product by the weight of the ball in pounds; the quotient thus obtained will be the distance in inches from the centre of the weight on lever to the centre of the stud or fulcrum, or "the length of the lever," as it is called.

To find the weight of the ball on a safety valve take the total pressure on the valve and multiply it by the distance in inches from the centre of the stud or fulcrum to the centre of the valve stem in line with the lever; now divide this product by the length of the lever in inches (from centre of stud or fulcrum to centre of weight on lever); the quotient thus obtained will be the weight of the ball in pounds.

* * * *

Editor "PRACTICAL ENGINEER":

Your answers to J. W. Bearden's questions in your issue of February, are, I think, open to a little qualified criticism.

"In the first place," the spring used in an indicator is never "entirely too light" if, as his diagrams show, the pencil can and does dart above the initial pressure shown without apparently reaching the limit of its upward movement, though if he really had 100 lbs. boiler pressure in one case, the 40 lb. spring was too light, but was barely strong enough for 90 lbs., provided the limit of the upward movement of the pencil corresponded to my original layout for the Thompson Indicator parallel movement, which appears to have been followed in the "Robertson-Thompson", though I have never examined one. My limit was about 2½ inches, which easily permitted the use of 40 lb. spring for 90 lbs. boiler pressure, but practically excluded it for 100 lbs. boiler pressure. But it is true that a stronger spring would, as you say, diminish the vibration, possibly a little more in proportion than it diminished the area of the card, although it is doubtful whether it would in any degree facilitate accurate reading.

But the experience of over a quarter century has led me to pay little or no attention to the reported boiler pressure, as gauges nearly always weaken and show too much pressure after use. The only way to get it reliably is to stop the engine on the center, let in full pressure to the indicator, pull the cord and draw a line, which will give,—if not the absolutely correct pressure,—the correct pressure by which to judge the per-

formance of the engine or indicator. But every engineer who takes an interest in the study of the performance of his engine, should have fittings for taking what are now known as *pipe diagrams*, i. e., a connection between the steam pipe and the indicator, preferably where the steam has passed the throttle. Diagrams taken from this connection immediately after taking the working diagram, show the fluctuations of pressure in the steam pipe, and also how nearly the pressure in the pipe is realized on the piston, and in this way a loss of only one or two pounds is frequently shown when a comparison of gauge and diagram will perhaps show a loss 10 lbs., or more.

The vibrations of the moving parts of the instrument causing undulations in the curves are not at all objectionable when not so excessive as to prevent sufficiently accurate measurement. Ordinarily, following the sinuosities with the planimeter will give sufficiently accurate results, although when they are excessive, the reading will be slightly below the true one. Bacon's rule to draw curves touching the extremes of the undulations and bisecting the included space is a good one, particularly in the absence of a planimeter; but like the planimeter, it will show slightly less than the true mean

These undulations are generally taken as good evidence of the free working of the instrument, so much so that their absence from high speed diagrams should be regarded as a suspicious circumstance, justifying examination for undue friction.

The lesser initial pressure at the head end is not due to leakage, but to the more rapid movement of the piston to and from that end during the half travel nearest to it. Leakage of piston would effect both ends equally.

"The saw teeth" complained of is due to momentum. When the compression curve is correct throughout and no loop is formed, the excess of upward motion is no evidence of excess of compression, for if the compression did not do it, the induction or lead would. Whether the compression is too great or not must be decided by the perfoimaace of the engine. It has long been known that a certain amount is necessary for quiet running, which amount can only be learned by experience.

Salem, Ohio. F. W. THOMPSON.

We appreciate the above letter from Mr. Thompson very much, as it is both interesting and instructive. We agree with him throughout his letter with the exception, "Leakage of the piston would effect both ends equally." This statement we will have to dispute, as we know of several instances where a leakage has occurred on one side of the piston while the other side was tight as a drum.

EDITOR.

* * * *

Editor PRACTICAL ENGINEER:

I would like you to estimate for me the horse-power of a Corliss engine 12 by 36 inches, 93 revolutions, boiler pressure 100 pounds. Also the horse-power of a boiler 14 feet by 60 with 90 three-inch flues. Size of grates are 5 feet by 3 feet.

JOHN J. LYNN.

[The horse-power of your engine may be found by multiplying the area of the piston by the mean effective pressure and then by the length of the stroke in feet. Divide this by 33000 pounds—for instance, the area of your piston is 113.10 square inches times 60, (the mean effective pressure cutting off at ¼ stroke) times 558 feet (the piston travels per minute)$=\frac{3774588}{33000}$ =114, which is the horse power your engine will develope at full load. The only means of accurately determining the horse-power of a boiler is by the evaporation test, but as this is not always practical or possible we have several means of getting at an approximate result, which is usually what is wanted.

The rating for a simple Corliss engine is 12 square feet of heating surface per boiler horse-power. The simplest rule and the quickest way to find the heating surface of a boiler is to multiply the number of square feet of grate surface by 45—thus we have in your case 3x5x45=56.25, the horse-power of your boiler.—Editor.

* * * *

EDITOR PRACTICAL ENGINEER :

Is the following correct, as I got it in answer to a question to the American Machinist some twenty years ago? "To find the point of cut-off that will reduce the terminal to atmospheric pressure divide the boiler pressure plus the atmosphere; this will give the denominator of a fraction of which the numerator will be one."

Take a boiler pressure of 180 pounds, and we have to cut off according to this calculation 1–13 of the stroke.

2nd. How do you figure the expansion of steam in a cylinder? Take, for instance, a cylinder full of steam of the above pressure, 180 pounds, and cut off at 1–13 of the stroke as we are reckoning from vacuum. Would you call up to the point of cut-off one expansion, or 13 expansions in all?

CRANK PIN.

Your rule is only nominally correct and then only in case you have a true gas, which steam is not, as during the expansion you have to contend with condensation, and, toward the end of the stroke, re-evaporation. In addition to the above you have to reckon on the various clearances of different engines. Hence, we might say that the rule only applies where there is no clearance and no condensation, so that it is not a certain method of figuring in the case of steam engines.

2nd. As we understand this question your idea is that you want to move the piston forward and divide the movement into 1–13ths. In case of cutting off at 1–13th stroke you do not have thirteen expansions, but only twelve, as the first 1–13th of the stroke is made at full boiler pressure, while the expansion only begins after cut-off takes place.

EDITOR.

* * * *

A Novel Combination Feed Water Heater and Water Arch

The shortness of life of boiler fire door arches has long been a source of trouble and expense, as has also the scaling of boilers. The following article illustrates an appliance, which is said to not only overcome both of the above named objectionable features, but also combines with it a very effective feed-water heater. The novel features introduced appears to be of interest to engineers and will probably be deemed worthy of adoption. The apparatus is applied in the manner indicated by the engravings and is arranged so as to be at all times full of water.

Once the "Combination" is installed there is no further brick work to the front of the boiler necessary during its natural life, and one of the greatest drawbacks to the engineer is eliminated, as it often occurs that the arch falls in during a heavy run, and at a great inconvenience the boiler must be shut down for repairs.

The additional horse-power obtained is one of the strongest features of the appliance, as that addition is gained without the

loss of space and without disturbing any of the fixtures or parts of the original installation, and can be applied to any boiler in twenty-four hours.

The strain on the boiler due to contraction and expansion is

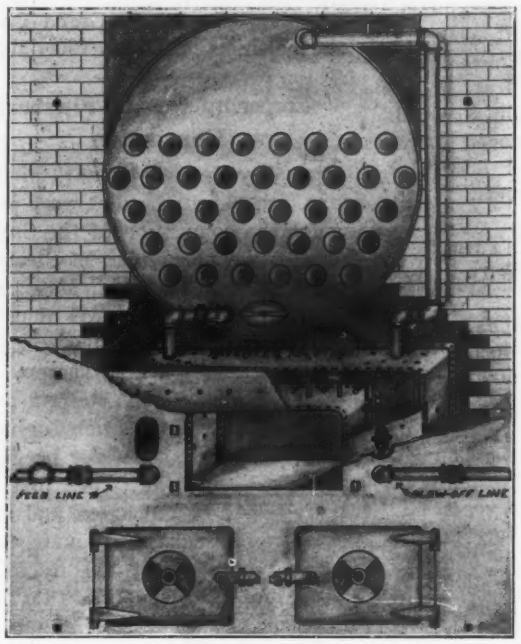


Fig. 1

greatly reduced by supplying water at high temperatures, thus increasing the life and efficiency of the boiler.

The feed water for the boiler is fed into this arch through the connection shown and the heat usually absorbed and dissipated by the brick arch is in this apparatus used to heat the feed water. The high temperature which it attains causes many scale-forming substances to be precipitated at the bottom of the said arch, whence they may be blown off. It is connected to the boiler in such a manner that a good circulation is maintained, even though no water is being fed.

The water arch is constructed of steel plates, riveted, with ¾-inch steel braces placed at intervals of six inches. They have

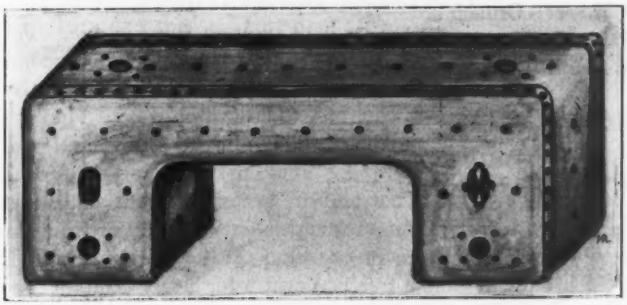


Fig. 2

two 2x4-inch hand holes and covers for the same, the hand holes being in a position so that the interior of the water arch can be easily reached. The connecting pipe for the feed water and connections to the boiler drum and tubes proper is by means of a 2-inch pipe and the blow-off pipe is of the same dimension.

For further particulars apply to Neil W. MacIntosh, 54 John Street, New York City.

The "Nason" and "Sidelug" Traps

In selecting a trap it may be well to study the design of the "Nason" and "Sidelug" traps, manufactured by the Nason Manufacturing Co., 71 Fulton Street, N. Y.

For facility of access to the sleeve seats and sleeves, the two larger sizes are fitted with handhole plates on the covers, which permit of getting at the working parts without breaking the main joint.

The cut shows the exterior appearance of the "Nason" traps. They are constructed as follows:

A cast iron reservoir or pot, closed with a cover, provided with two cored passages, contains a float, which is fitted with a spindle for its guidance. A housing or sleeve is screwed centrally into the under side of the cover, and within it the float spindle slides smoothly, permitting a short vertical motion. The top of the float spindle is ground flat, and its upward movement is arrested by coming in contact with a bronze plug having a central opening, the two surfaces thus constituting a discharge valve for these traps.

One of the cored passages in the cover alluded to is for the discharge of water from the traps, after passing through the main valve, and the other serves as a by-pass, to permit any large volume of air or water to be blown through, when starting, without going through the cylinder and discharge valve. A valve located externally in the cover gives control of this action.

The trap should in all cases be placed below the surface from which water of condensation flows; the discharge

enters at the point marked "Inlet," and, passing through the "cored opening" into the body of the trap, a diaphragm above the float diverts the water of condensation into the pot, where, gradually rising, it first raises the float, thereby closing the discharge valve, and then, after reaching the top of the float, it flows into it. When the float has nearly filled its weight becomes such that it overcomes the tendency of the discharge valve to remain closed, being held there by steam pressure, and the float drops to the bottom, thereby opening the valve. Acting on the surface of the water, the steam pressure immediately drives it up through the sleeve, discharge valve, and thence, by way of the cored passage, to the outlet.

When the float has been nearly emptied it becomes so light that it is again raised by the water about it, thus closing the valve, and the operation is repeated.

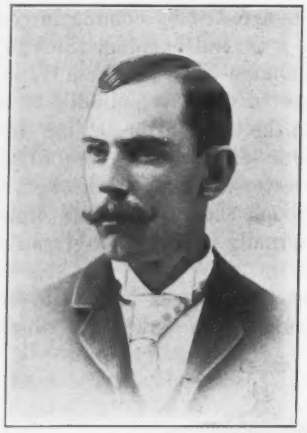
This action is purposely intermittent, which necessitates that the valve shall be either wide open or completely closed, an advantage which entirely obviates "wire drawing." The life of the valve is thus indefinitely prolonged, and danger of leakage at this point reduced to a minimum.

Society News

American Order of Steam Engineers

Boston Council

The above Council held a very interesting meeting at their hall, 724 Washington Street, Boston, Mass., on December 27th, at 8 p.m. It being understood that each member would bring a gift to the Council, a very good collection was obtained. Brother Abbott gave $10 in gold, same to be given the



Harry G. Black

member bringing in the greatest number of new members, in excess of five, during 1903. Brother Smalley gave an indicator, which, although it had seen better days, was duly appreciated.

Wm. T. A. Faulkner

Brother Black gave a small steam pump, in which is fitted a special piston invented by himself. Every brother gave something to be used in the educational work of the Council. An examination of the roll from December, 1900, till December, 1902, showed eleven members were absent four meetings, Brother Black absent two meetings, and Brother Faulkner perfect attendance. The following were then elected officers for the ensuing year:

Chief Engineer, Albert R. Abbott.

First Assistant Engineer, Freelin C. Smalley.

Recording Engineer, Philip Sanford.

Financial Engineer, Constance Lockhart.

Treasurer, James L. Merrett.

Chaplain, R. F. McKay.

Senior M. M., George E. Turner.

Junior M. M., William Kelly.

Inside S., H. G. Black.

Outside S., William F. Jenkins.

The Council extends a hearty welcome to any Brother to attend any of its meetings.

We produce herewith portraits of two active members of Boston Council. Harry G. Black held the office of financial engineer for two years, and the office of chief engineer for the year just past. Mr. Black is chief engineer of the Albany building, Boston. William T. A. Faulkner has held the office of corresponding engineer of the Council for the past two years.

Columbia Council

Grand Chief Hiram Trout installed the following officers of Columbia Council No. 18, on Jan. 17th, in which he was assisted by Grand Recording Engineer Al. Keppleman; Chief Engineer, Amos Simmons; Assistant, John McLane; Corresponding and Financial Engineer, W. J. Courtney Treasurer, John Schlossman; Senior Master Mechanic, Daniel Eckman; Junior Naster Mechanic, William Raum; Inside Sentinel, Henry Messer; Outside E. McLaughlin; Chaplain, C. Mathiot; Trustees, Albert Kimes and Ambrose Bartch.

Following the installation ceremonies the installing officers both favored the Council with interesting speeches.

Southwark Council

SOUTHWARK COUNCIL.

The following newly-elected officers of Southwark Council No. 4, Philadelphia, were installed by Grand First Assistant John Kelly, assisted by J. K. Holland, acting as Grand Senior Master Mechanic, on Jan. 12th; Chief Engineer, L. K. Covington; Assistant, Hugh Ryder; Financial, F. R. Moore; Treasurer, Wm. Small; Recording and Corresponding, Wm. McDowell, 1913 S. 8th St.; Chaplain, John T. Murphy; Senior M. M., Robert Cardwell; Junior M. M., Geo. A. Banks; Inside Sentinel, Geo. Melchert; Outside Sentinel, Wm. Conner; Trustee, Thos. Marshall; Delegate to Grand Council, John McKinney, Alternate Chas. Myers.

Preparing for the Pittsburg Convention

Iron City Council No. 21, of Pittsbutrg, are already hard at work preparing for the convention of the Supreme Council American Order, of Steam Engineers, to be held there in May, and the delegates may feel assured that in so far as Iron City Council is concerned, the Convention will be a success.

The Committee of Arrangements, to be known as the Convention Committee, has been selected and have began preparations with a will. Their first move was to secure headquarters, and in this they were particularly fortunate, having secured the Victoria Hotel, where there will be ample accomodations for all the delegates and officers, and also for agents and supply men wishing to attend. However, the latter should make early application for rooms, for there will be several other conventions in Pittsburg, at the same time and hotel accommodations will doubtless be at a premium unless secured early. The special feature of the Victoria is that the Convention will be held right in the hotel, a large assembly room having been secured for the purpose. Another equally interesting feature is that the Committee are arranging to have quite an extensive exhibition of machinery, steam specialties, and engineer's supplies. This, also, will be held right in the Victoria. For this purpose two large adjoining rooms have been engaged; they communicate by means of two large arch-ways. They are 36x60, are high in the ceiling and well lighted. These rooms are on the second floor and are accessible from the street by an independent stairway or from the main corridor of the hotel. There is a freight elevator for heavy exhibits. The affair will be well advertised locally and provision will be made for the accommodation of vistors either day or evening. The charge for space will be the same to all, and those applying first will get the best positions. All communications should be addressed to Mr. Frank C. Rose, St. Paul's Orphan Asylum, Idlewood. Pa.

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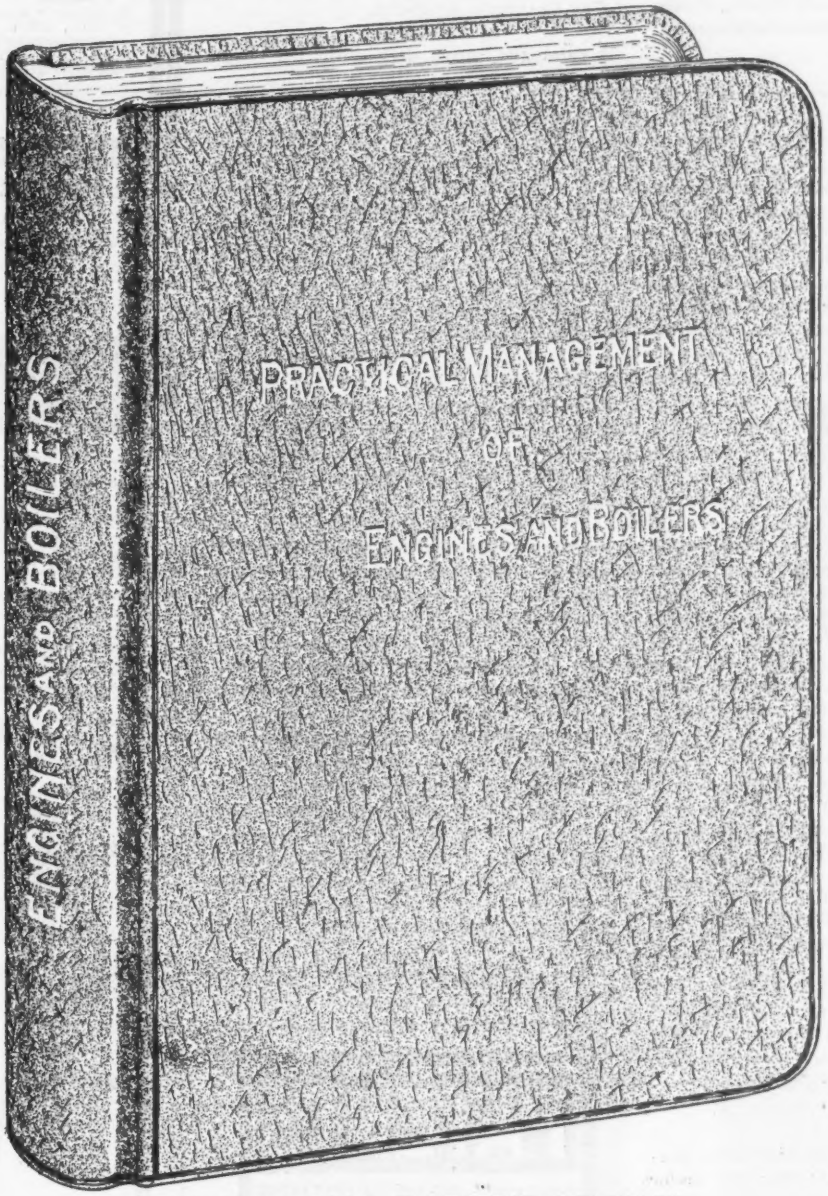

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THE PRACTICAL ENGINEER

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TRADE NOTES

Engineers having trouble with belts, whether leather, canvass or rubber, should write the Grand Belt Dressing Co., Allentown, Pa., for free samples.

If interested in metallic packing for either steam, water or ammonia, write to The France Packing Co., 6502 State Road, Tacony, Philadelphia, for a copy of their handsome illustrated catalogue.

Nonpareil Cork pipe covering may again be had in any quantities desired. Some months ago the plant of the Nonparell Cork Manufacturing Co., at Camden, N. J., was completely destroyed by fire. It has now been rebuilt and the company are working night and day to supply the demand.

The Pittsburg Coal Co. have given order for six 150 h. p. tubular boilers, destined for its various mines, to the Pittsburg Gage & Supply Co., Pittsburg, Pa.

The Penfield Coal Co., Penfield, Pa., has also placed order for one 40 h. p. Chandler & Taylor engine and one 50 h. p. horizontal tubular boiler to the Pittsburg Gage & Supply Co., Pittsburg, Pa.

The Geo. W. Lord Co. have recntly been incorporated and have succeeded to the business of Mr. George W. Lord, manufacturers the well known Lord's Boiler compounds. A large addition to the factory has just been completed making the fourth addition within the past three years and largely increasing the capacity, thus placing the company in position to furnish the highest grade of water purifying chemicals in any quantities desired at shortest notice.

A machine that will pay for itself within a month and still be as good as new looks like a pretty good investment. M. W. P. Barnum, of 41 Newton street, Fredonia, N. Y., claims that this can be done with the Standard Valve reseating machine which he manufactures. He sends them on trial, so he must be pretty sure of their value.

Kinetic Electric Co., 16 South Schell St., Philadelphia, are now building dynamos and electric motors of all sizes and for every service; small sizes in stock. Prices and further information will be furnished upon application.

The Elegant New Brick Factory of the Keystone Chemical Mfg. Co., of Camden, N. J., is now completed and will have a capacity for turning out from six to eight million pounds of pure Keystone Tri-Sodium Phosphate annually. The Company report that the demand for this product for purifying boiler feed waters has increased wonderfully of late, they having received several orders during the past month for car load lots.

"Let's Talk It Over" is the title of an attractive and handsome circular just issued by the Lagonda Mfg. Co., Springfield, Ohio. They will be pleased to send a copy to any of our readers who are interested in Tube cleaners and feed water regulators, which they manufacture.

The Burt Mfg. Co. have shipped during the past month six oil filters to Sidney, Australia' five to Stockholm, Sweden, and five to Johannasburg, South Africa.

A nice catalogue has recently been issued by Manzel Bros., 50 and 52 Broadway, Buffalo, N. Y., a copy of which will be sent to any reader of THE PRACTICAL ENGINEER.

A catalogue, giving sizes, capacities, prices and many illustrations, together with considerable information of value, has been issued by The National Pipe Bending Co., 157 Lloyd St., New Haven, Conn. Copies will be sent free to any one mentioning this journel.

A New Calendar for 1903 has been issued by the Eagle Oil & Supply Co., 104 Broad St., Boston, Mass. Copies will be sent to engineers and steam users upon request. This is a particularly attractive calendar, consisting of twelve pages 11 x 14 in size, with an appropriate illustration on each page.

Those interested in electric hoists for any purpose, can secure an interesting little booklet describing several different types, by writing to C.W. Hunt Co., West New Brighton, Staten Island, N. Y.

A Free Sample can of Keystone Grease and a Keystone brass cup will be sent free of charge to any of our readers who desire to give it a trial. This is a magnanimous offer and should be accepted by those interested in economical lubrication. Address Keystone Lubricating Co., 20th and Allegheny avenue, Philadelphia.

"In times of peace, prepare for war" seems to be the slogan of the Fort Wayne Electric Works, Fort Wayne, Ind. For despite the zero weather which has been prevailing, they remember that in summer time we sigh for a cooling draught. Recognizing this condition they are sending out quite an elaborate catalogue describing a very complete line of electric desk fans. These fans are in many instances in a much more advanced stage of evolution than those of past years, and it will pay anyone interested to write for a catalogue and look them over.

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IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 440 Liberty Street, Allentown, Pa.

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"The old reliable" Jenkins Bros. have issued their 1903 catalogue, which following precedent will be sent to anyone free of cost. The book contains information concerning valves and their construction, which every engineer should know; in addition to that there is much of general interest about packing, steam traps, etc., within its covers, and your library will be incomplete without a copy of this valuable catalogue.

"Fuel Saved." power increased, smoke prevented" is the heading of a very attractive book issued by the Steam Boiler Equipment Co., 20 West Houston St., New York City. It contains a thorough description of the "Hydro Carbon" system of steaming a boiler and is replete with very fine engravings showing numerous installations of their system. A postal card mentioning this paper will secure you this work free of charge. As there is probably nothing more universally used than coal, the reading matter will be of very great interest to anyone.

How often we need a drop forging, and how often we don't know where to get it; then, again, we don't always know whether what we want is a stock article or will have to be made special. An inquiry addressed to J. H. Williams and Co., Brooklyn, N. Y., mention of this paper, will secure you a handsomely illustrated catalogue of 100 pages, showing cuts and tables of drop forgings of every conceivable form. A specialty of drop forged wrenches is made in this catalogue hence it will be of value to any engineer.

The Newton Machine Tool Works, 24th and Vine Sts., Philadelphia, are sending out a handsomely illustrated booklet describing the multiplicity of machine tools which they make. To those anticipating the purchase of a lathe, or other like material, it will well repay the trouble necessary to secure a copy. A postal inquiry will secure it.

"Steam Users' Supplies" is the title of catalogue "E" by the Sims Company, Erie, Pa., It contains a very thorough description of the entire output of this Company. Among other things contained therein is a very clear delineation of the Sims Oil Filter, showing the ease of operation, etc. In fact the whole goes to show a very complete line of efficient steam boiler accessories which it will repay any engineer to get aquainted with. In writing please mention this paper.

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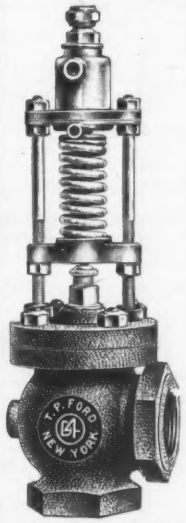

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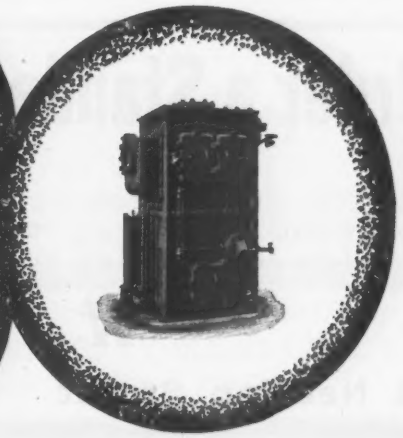

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Jennings Council, No. 2, meets every Saturday evening in American Bank. Chief Engineer, Daniel R. Jones. Corresponding Engineer, R. E. Funk.

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Deputy Supreme Chief Engineer, A. J. Deidrich, 226 North Caroline St., Baltimore, Md.

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Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. O. Daneker, 834 East Ave.

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Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

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Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, in Templar Hall, 724 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

ROCKLAND.
Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Chief Engineer, E. H. Naylor. Corresponding Engineer, Chas. W. Alden, Box 642, North Abington.

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Deputy Supreme Chief, F. O. Garrison, Bridgeton, N. J.

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Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.
Camden Council, No. 3, meets every Thursday evening at N. E. Cor. Second and Federal Sts. Chief Engineer, C. H. Harigle. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

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Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, Wm. Fowden. Corresponding Engineer, W. S. Price, Haddon Hall.

BRIDGETON.
Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.
Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.
John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

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Grand Chief Engineer, Hiram Trout, 1105 North Tenth St., Reading, Pa. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.
Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, L. F. Souders. Corresponding Engineer, Frank MacIndoe, 3529 Ainslie St., Falls of Schuylkill, Philadelphia.
Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.
Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Chief Engineer, C. W. Leng. Corresponding Engineer, Charles Fournier, 3115 Richmond St., Philadelphia.
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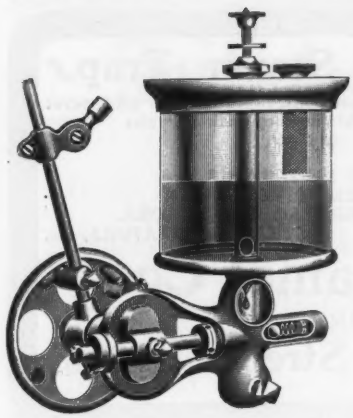

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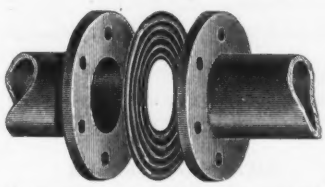

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They say **one** *engineer in town*
Has something that keeps coal-bills down,
And wages up,—now, Bill, look here,
Just tell a fellow-engineer."
Said Bill, "It's simple as can be:
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Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, John Hill. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Thursday evening at Kensington Ave. and C St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Frederick Markoe. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.

Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, Phillip W. Sutton. Corresponding Engineer, F. C. Rose, 10 Federal Street.

GIRARDVILLE.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John Durrin. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Wm. Rickert. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, A. B. Hess. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, Amos Simmons. Corresponding Enginner, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, H. E. Culp. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

MILWAUKEE.

Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

Clifford P. Williams Council, No. 2, meets every Thursday evening at 298 Fourth St. Chief Engineer, David T. Richardson. Corresponding Engineer, Jas. T. Harris, 1611 Clybourn St.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

NASHVILLE.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

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Deputy Supreme Chief Engineer, Nat. Freese, Grant's Pass, Oregon.

GRANT'S PASS.

Oregon Council, No. 1, meets every 1st and 3rd Saturday in A. O. U. W. Hall, Main St. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese.

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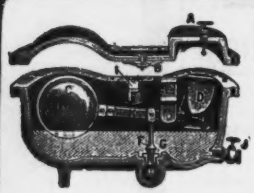
Galveston Council, No. 1, meets every 2nd and 4th Tuesday evenings at Engineers' Hall, S. W. Cor. Twenty-second and Strand Sts. Chief Engineer, Max Levy. Corresponding Engineer, A. L. Bradford, Union Depot.



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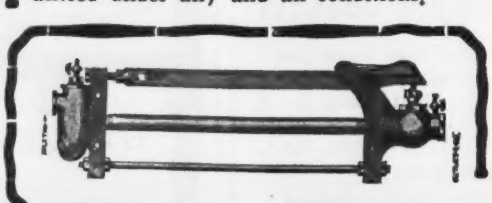

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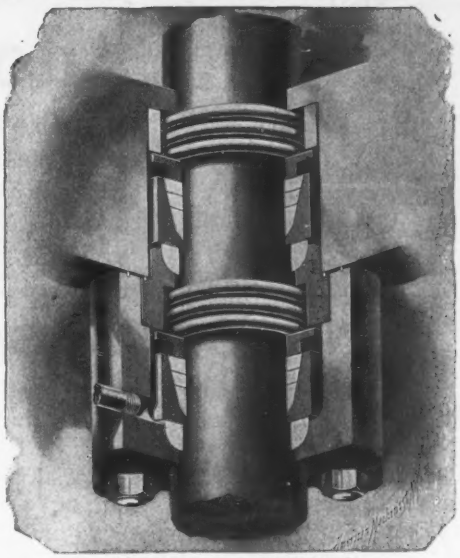

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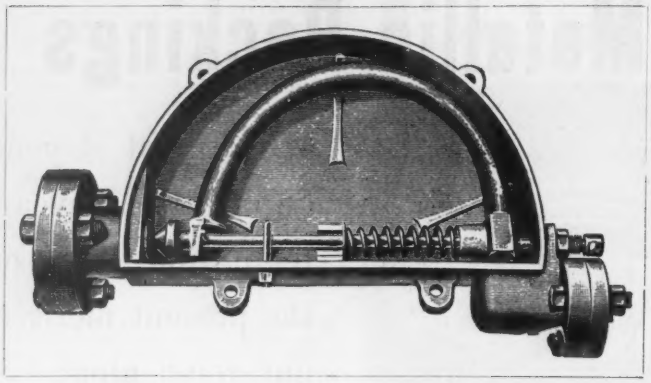

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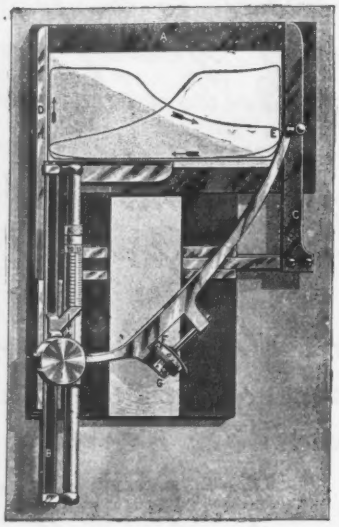

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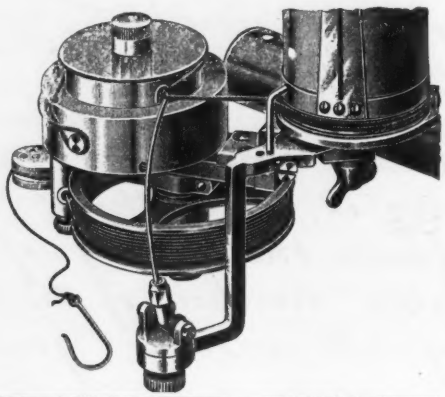

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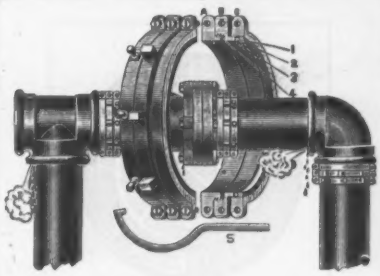

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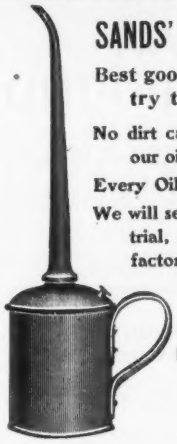

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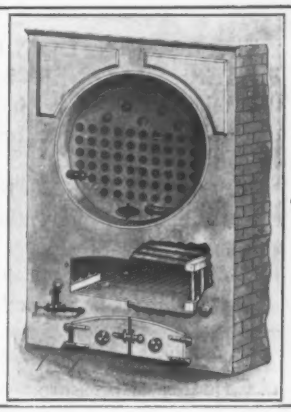

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The BRUUN-LOWENER WATER SOFTENER is better than others on so many vital points that they ought to be read over slowly.

The water is purified before it enters the boiler, preventing scale and saving fuel.

It can be treated hot or cold.

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It is uniform in its work under all variations of pressure.

And yet it costs less than any other.

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AMERICAN BOILER COMPOUND
Our compound is the result of years of experiments by an engineer of long experience, assisted by expert chemists.
American Boiler Compound not only completely removes all scale and incrustation in the boiler, but prevents new from forming, and will, if properly used, keep the boiler absolutely clean and free from all forms of corrosion, such as pitting, grooving, honeycombing.
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We will be pleased to hear from engineers who will secure trade for us. When writing for information address
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is not the "growth of a night." It has been slow, but always steady. Might have grown faster by bluff, brag and gift enterprise methods, but I prefer doing business on merit and principle, even though it takes longer. So I make overalls that for careful attention to every point which adds to comfort, service and neatness, are without equal and I stand by every garment I send out.

The **Patent Safety Watch Pocket,** fleece lined, can only be had on my goods, and I'll gladly tell you all about them if you'll write me. Insist upon having

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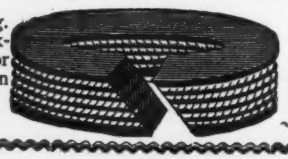
THE ORIGINAL RING PATTERN
Self-lubricating, Steam and Water Tight, Less Friction than any other known packing. **None Genuine Without This Trade Mark Stamped on Wrapper.** All similar packings are imitations. In ordering give exact diameter of Stuffing Box and Piston Rod or Valve Stem. Our Packing is a sure cure for leaky stuffing boxes, whether the motion is rotary or reciprocating.



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made either with **Rubber or Canvas Core** and both **Round** and **Square** in shape. Will give satisfaction on Engine, Pump, Compressor and Valve Rods. Easiest of all packings on your rods.

Brandt's Triple Expansion Gaskets

For Boiler Work and

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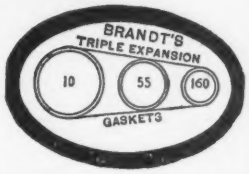

are the very best goods you can use in **High-Pressure** work. Engineers are requested to give the above a trial if they are not now using them.

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Sole Manufacturer and Proprietor

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BECAUSE THEY

CLEAN TUBES CLEAN.

We make several styles

POWER DRIVEN CLEANERS, for large plants or very heavy, hard scale. Decidedly the cheapest, efficiency, time and operating cost considered.

WATER POWER CLEANERS. Inexpensive, strong and durable—unequaled in this line.

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All Guaranteed and Sent on Approval.

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Write us about boiler cleaning—we're experts; have had twenty years experience and "know how." Mr. Weinland, a *Practical Engineer*, being the pioneer and first inventor of Turbine Tube Cleaners. Send for illustrated catalogue.

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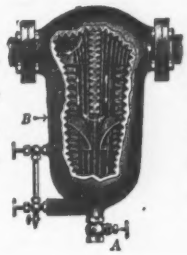
Where does it go to?

Some manufacturers say their packing don't have to be taken out—simply new on top of old. This fellow evidently sees the effect of packing passing through the cylinder.

"**EUREKA**" seldom needs removal. Its first cost is less than half—its wearing qualities double. It saves time, money, power and engine wear.

Engine hammer—

water in cylinder—loss of power. Waste of steam and fuel, larger expenses, possible wreck of engine.



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is a safeguard against such troubles and its cost is but trifling.

The outside

of a cheap **Indicator,** like a cheap watch, can be very attractive. It's the **inside** that represents value and efficiency.

In the **ROBERTSON-THOMPSON** an engineer gets his money's worth and pays no more than cheap ones cost.

Wait awhile,

if you can't afford to buy a good **Reducing Wheel or Planimeter** now. You will be disgusted with the cheap ones. Behind the **VICTOR WHEEL** and **WILLIS PLANIMETER** is our fullest guarantee, and that's worth considerable. If you are likely to purchase, better look over our catalog first.

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The Tornado Boiler Tube Cleaner

Requires LESS steam than any other cleaner.
Will positively clean BETTER than scraper or brush.
Will clean ANY length tube.
In operation is EQUALLY balanced, insuring NO back pressure against operator.
Is the LIGHTEST and EASIEST cleaner to handle.
Has NO working parts.
Its force is tremendous.

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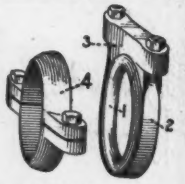

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2 The Flexible Yoke.
3 Cross Head.
4 Split Collar, which keeps the packing in place.

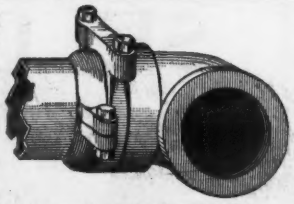
IF you have a leaky joint dripping water over valuable property, use one of **SMITH'S CLAMPS** and it will make a permanent repair.

It has no equal for simplicity, durability and low cost.

If your leak is in an inaccessible position, the use of our clamp will prevent having to tear out the piping. The illustration will tell the rest.

This Clamp is particularly adapted to close pipe connections, as it occupies less space than any other Pipe Clamp manufactured, and is cheaper, too.

In ordering, state size of pipe and for what it is used. Write for price list. Patent applied for.



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Our Lubricant is a lubricating compound, made from several of the best known lubricating oils, contains *no acids*, does *not gum* or *run*. It *cools hot journals* and *keeps them cool*.

It is applied by being packed in cups fitting air-tight on the journal, and feeds by suction, therefore there is no wasts when the journal is stopped. One cupful lasts from **2 to 10 months.**

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CHEMICAL PURIFIERS

that do this without injury to the boiler, its fittings or connections;

CHEMICAL PURIFIERS

that can be used with perfect safety in Breweries, Ice Plants, Dye Works and all places where the water of condensation is used for any purpose.

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Send for Catalogue.

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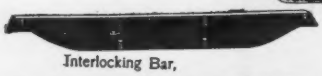

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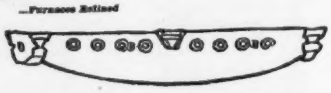

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GRATE BARS of all kinds,
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This work contains over 900 pages and 400 fine Illustrations. Every branch of Engineering treated in a scientific and comprehensive manner.

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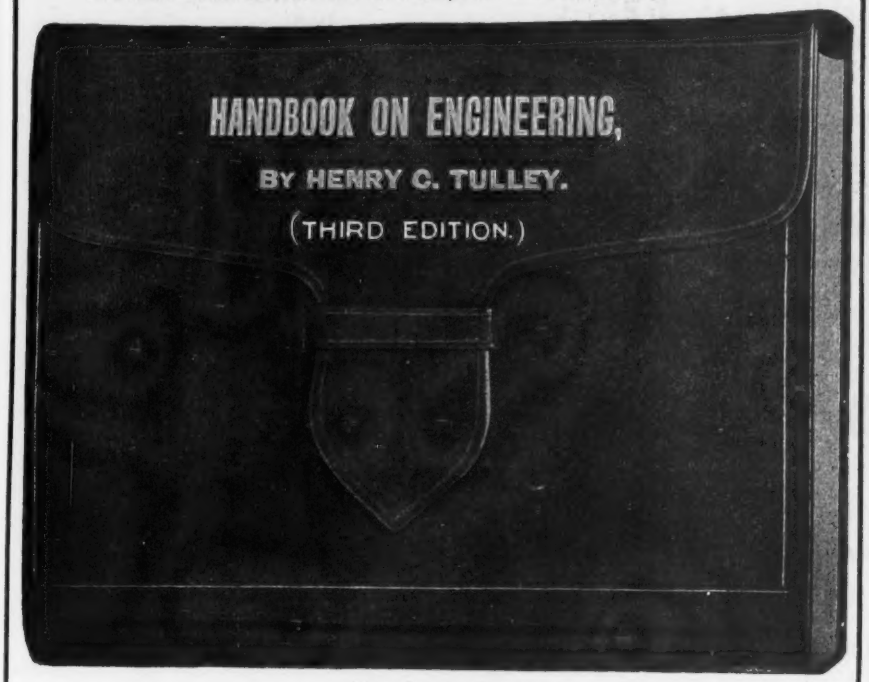

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WILL REMOVE SCALE, GREASE AND DIRT FROM STEAM BOILERS

Saves fuel; purifies the water; prolongs the life of the boiler; prepares the water to make pure steam. Its action on old scale is gradual but certain. Prevents grooving, pitting and wasting of iron. Does not injure or corrode the iron. Contains no acids.

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Has no complicated parts to get out of order.

Makes it possible to burn lowest grade fuel or refuse products.

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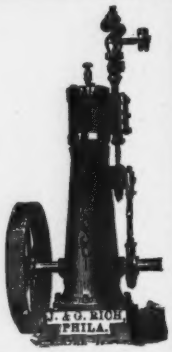

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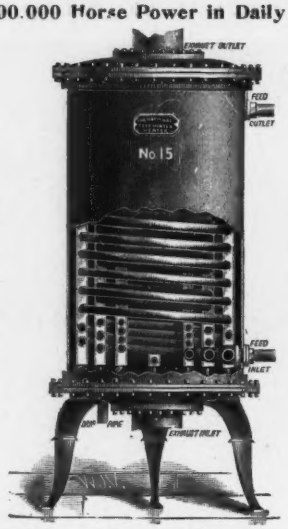
THE NATIONAL FEED WATER HEATER

1,100,000 Horse Power in Daily Use

Heats water to 210 degrees.
No inside joints to leak.
No straight tubes to leak.
No back pressure.
No contact of water with shell.
No chance for grease in boiler.



A heater noted for its Simplicity, Reliability, Effectiveness, Cheapness.

Heaters in use 20 years without repairs.
We manufacture the original and only genuine first class Coil Feed Water Heater.

THE NATIONAL PIPE BENDING CO.
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Kellam Damper Regulators

The Simplest and Closest Damper Regulator.

Manufactured by

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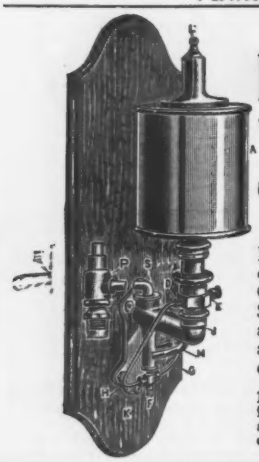

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Old Kellam Regulators Repaired.
Correspondence Solicited.
Mention this paper if your inquiry is prompted by the sight of this advertisement. Catalogue D free on application.

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Feed Water Heaters and Purifiers

WATER-TUBE AND STEAM-TUBE

Cast Iron or Steel Shells. "∩" Shaped Seamless Drawn Brass Tubes

WE BUILD HEATERS FOR EVERY PURPOSE AND CONDITION

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Improved Berryman Water Tube Feed Water Heater and Purifier

A thoroughly up-to-date, reliable and efficient heater. Made to stand the highest pressure; and so constructed as to be utterly indestructible by the heaviest boiler it is possible to carry. Write for catalogue.

We have a few good heaters, second-hand, which we will sell cheap, ranging from 50 H. P. to 1000 H. P. Mostly taken in trade for our Improved Berryman water tube Feed Water Heater and Purifier. Every heater is **Tested and Guaranteed.**

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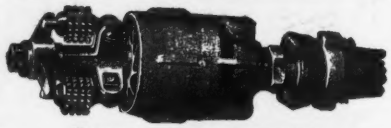
BOILER TUBE CLEANERS

CHICAGO TURBINE, PATENTED

THE TURBINE

IS THE ONLY PRACTICAL MACHINE FOR REMOVING SCALE FROM

WATER TUBE BOILERS



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THE PATENTS which we control cover all features essential to the design of a practical TURBINE TUBE CLEANER

We have suit for infringement pending against a user of the Lagonda or Weinland machine, and will prosecute all other INFRINGERS.

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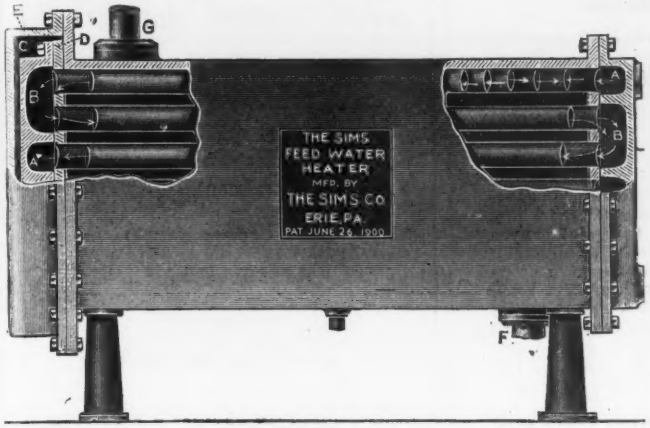
Gentlemen:—Answering yours of the 16th, the Heater we purchased of you some time ago has been in constant use and has given perfect satisfaction, it has done everything you promised for it, and we are highly pleased with the same. Awaiting your further favors.

Yours very truly,
JOS. KNITTEL SHOW CASE CO.

Write for catalogue "E" and learn all about this Heater and other steam appliances we manufacture.



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Thomas McAdoo
125 North Fourth Street
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The **OTIS** Tubular Feed Water Heater, Oil Separator and Purifier

with Seamless Brass Tubes

Guaranteed

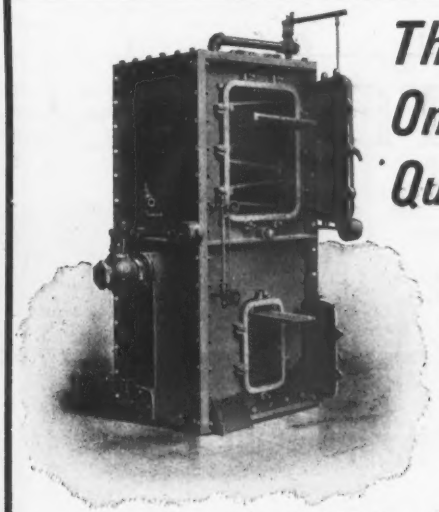
To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The **Stewart Heater Co.**

11 Norfolk Ave., Buffalo, N. Y., U. S. A.



The Only Question.

No manufacturer in this age asks, "Shall I have a feed-water heater?" The only question is,

"Which Feed-water Heater?"

Webster Feed-Water Heaters and Purifiers

are best because of their ability to save both heat and power, and purify the feed-water suitable for steam boilers. They act as "RECEIVERS" for condensation. They only use the steam required to heat the feed-water to the highest attainable temperature. And they do all this efficiency every day and hour.

Over 980,000 h. p. in use ought to prove a good deal—but you can get more proof by writing for it.

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STEAM ENGINES,

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CRANE FITTINGS

ESTABLISHED 1855

Saving of 10 Per Cent. in Coal Bills Guaranteed...

PAT. "AJAX" ROCKING GRATES.

The only shaking grate that will not get clogged up with clinkers.

The "Differential" motion does it. The crossbars A and B are journaled one on a higher plane than the other, and in rocking pass through the arc of a different circle bringing the two bars close together, which supports the bed

NO POKER NO SLICE BAR

of fuel, only allowing the ashes and clinkers to pass through.

Surface of grates **ALWAYS REMAIN LEVEL.** No fingers or points to disturb fire. Small clips No. 10 are all that can burn out and cost only a few cents each. Air space 65 per cent.

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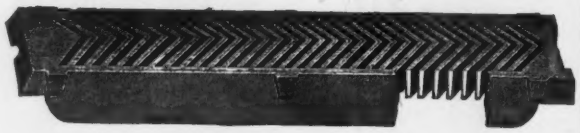
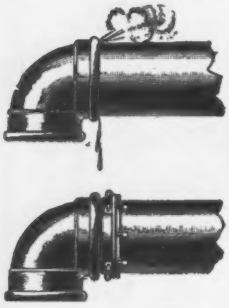
GRATE BARS

Rocking, Dumping, Tupper, Interlocking, Circular, Herringbone and common grates at prices that astonish you.

General Castings to Order. Tanks, Stand Pipes, Self-supporting Steel Plate Chimneys. Will call, take measurements and name prices. Phone 27-43-A.



Frick's Pipe Clamps for Stopping Leaky Pipe Joints

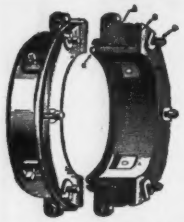


The **Best, Simplest** and cheapest **Pipe** clamp made. The cuts explain themselves. Only two rings and the packing needed to make any leaky joint tight. It is so simple that anyone can apply them.

The cost as compared with others is so little that owners of steam plants cannot afford to be without a full set of all sizes in case of need.

We make all sizes from 2 inches to 14 inches in diameter

PATENTED JUNE 25, 1901



A—Outside or main ring which is bolted around the pipe as close to leaky joint as possible, and secured to pipe by the set screws.
B—Gland which will slide backward or forward under the main ring and is forced up against the packing ring C by bolts and Nuts D
C—Empire or rubber ring which is forced into leaky joint by Gland B.

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Consulting and Contracting Engineers
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Electrical Construction
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ELECTRICAL REPAIR WORK A SPECIALTY

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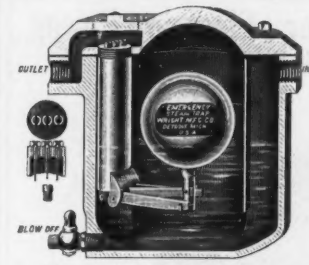

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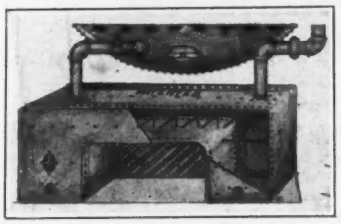

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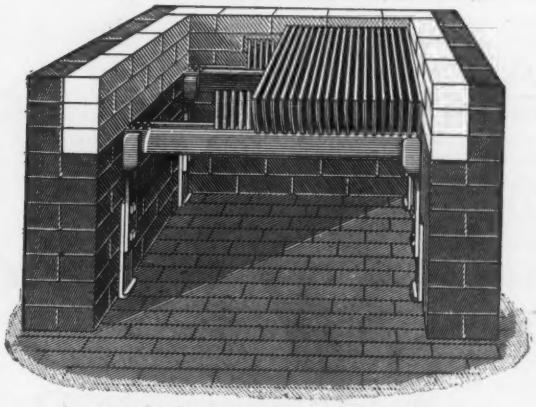

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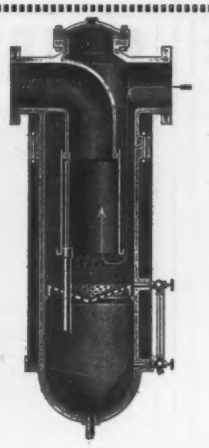

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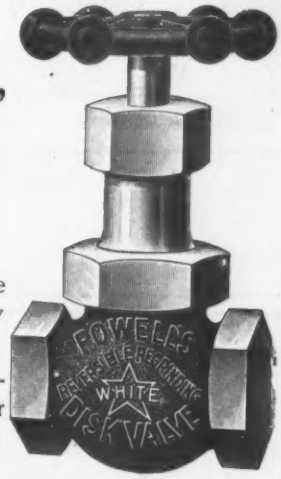

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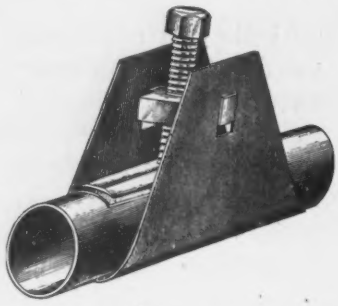

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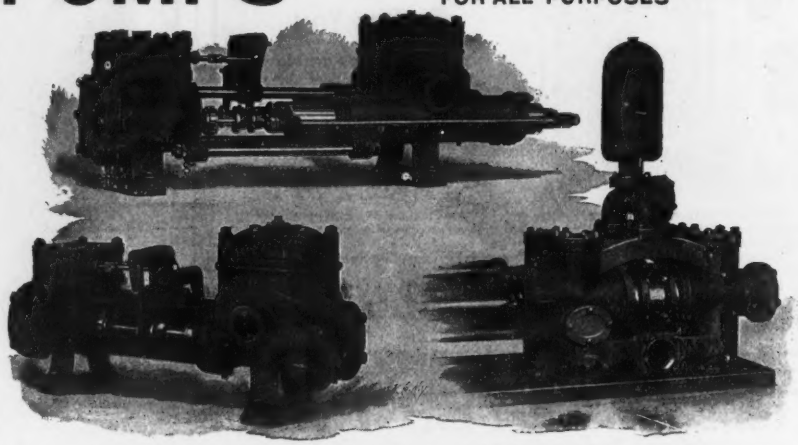

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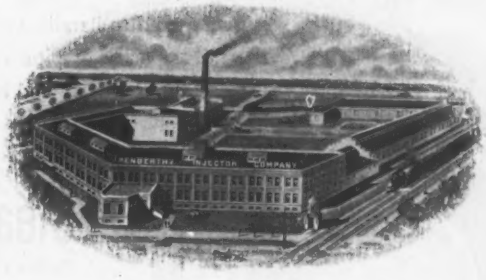

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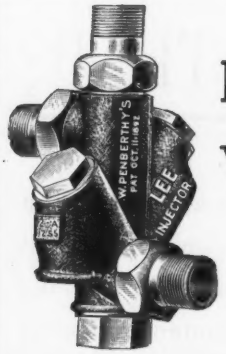

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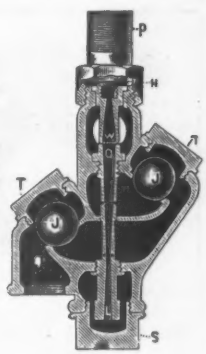

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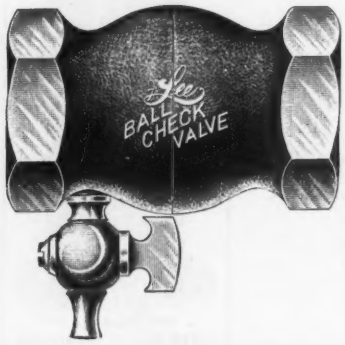

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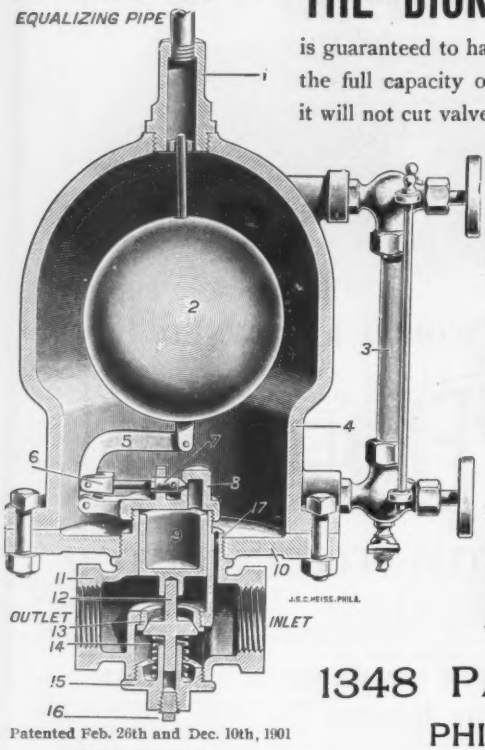

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For Pressures from 5 to 300 lbs.

The Bickel Thermostatic Steam Trap

is not adapted for Separator use or bleeding steam mains, but is unexcelled for every other service to which a trap can be put. It will respond quicker and last longer than any other expansion trap. Can be set to discharge water at any temperature. Will not cut valves.

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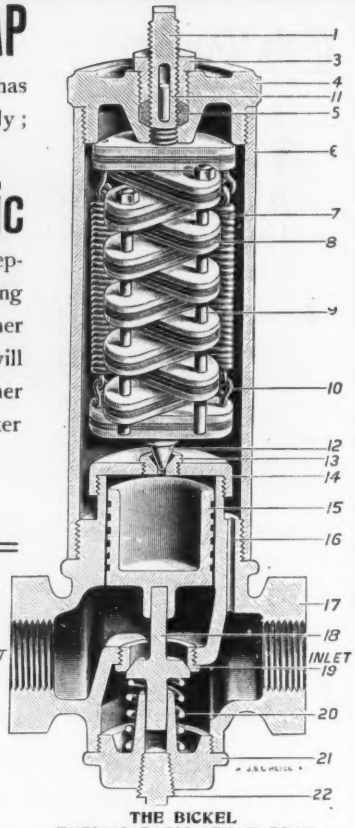

THE BICKEL THERMOSTATIC STEAM TRAP

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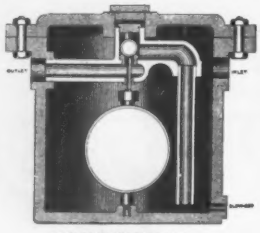

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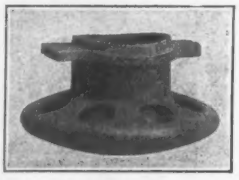

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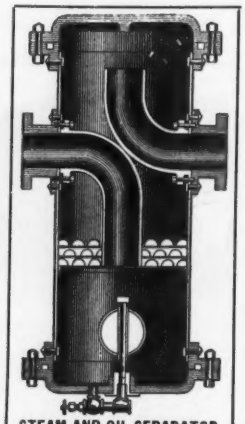

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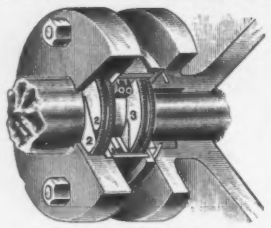

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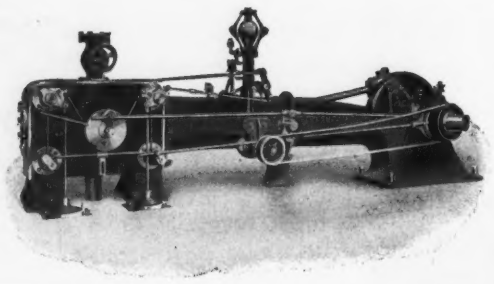

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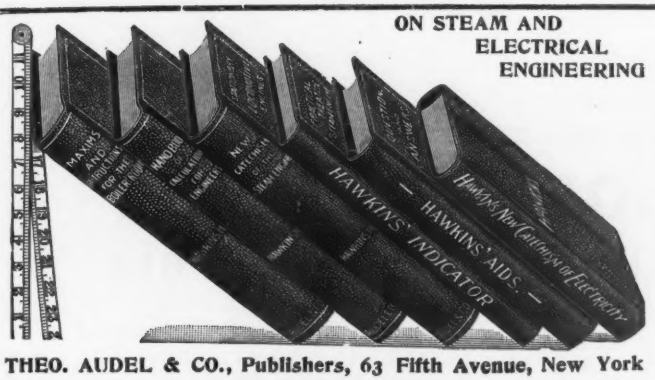

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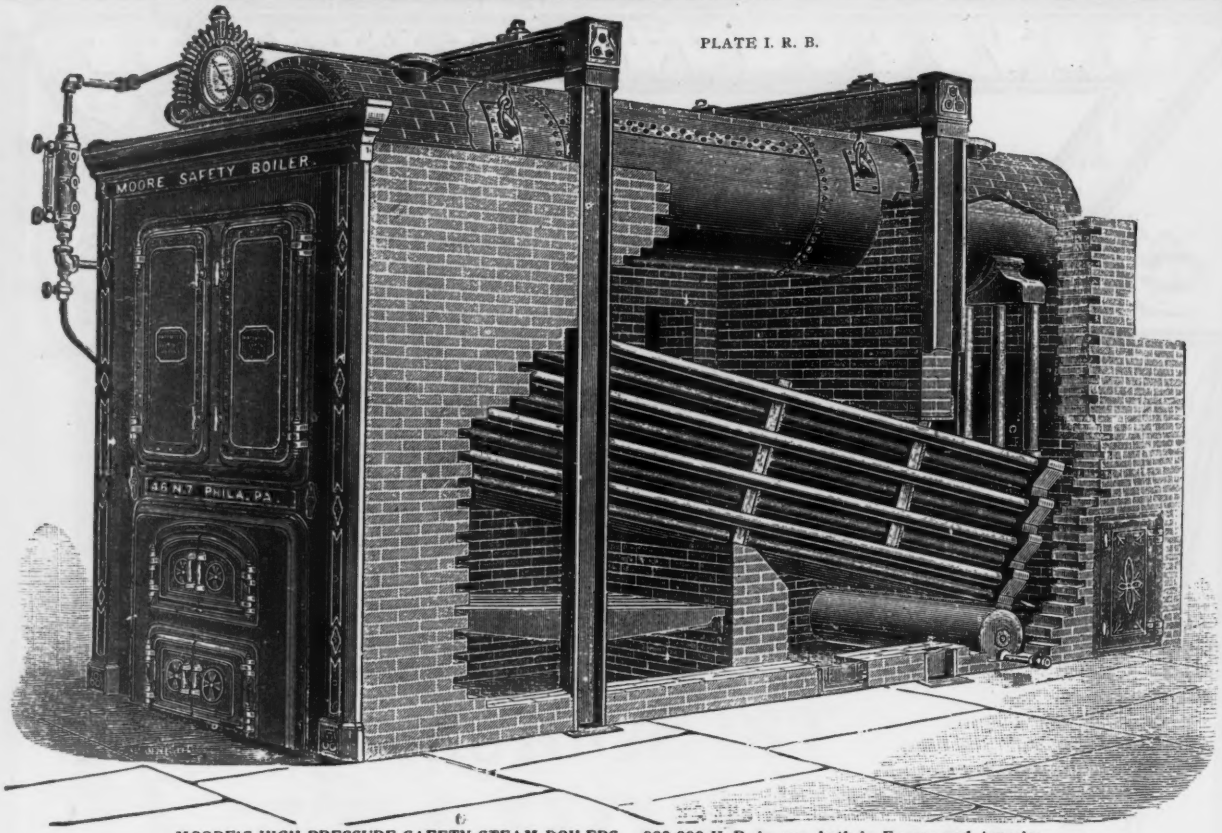

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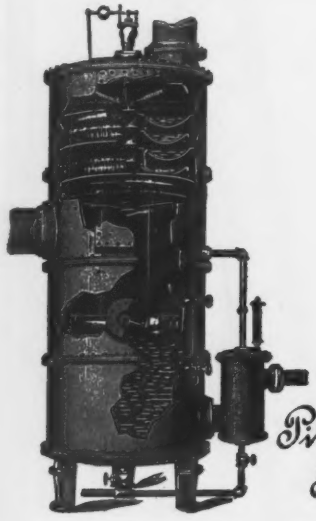

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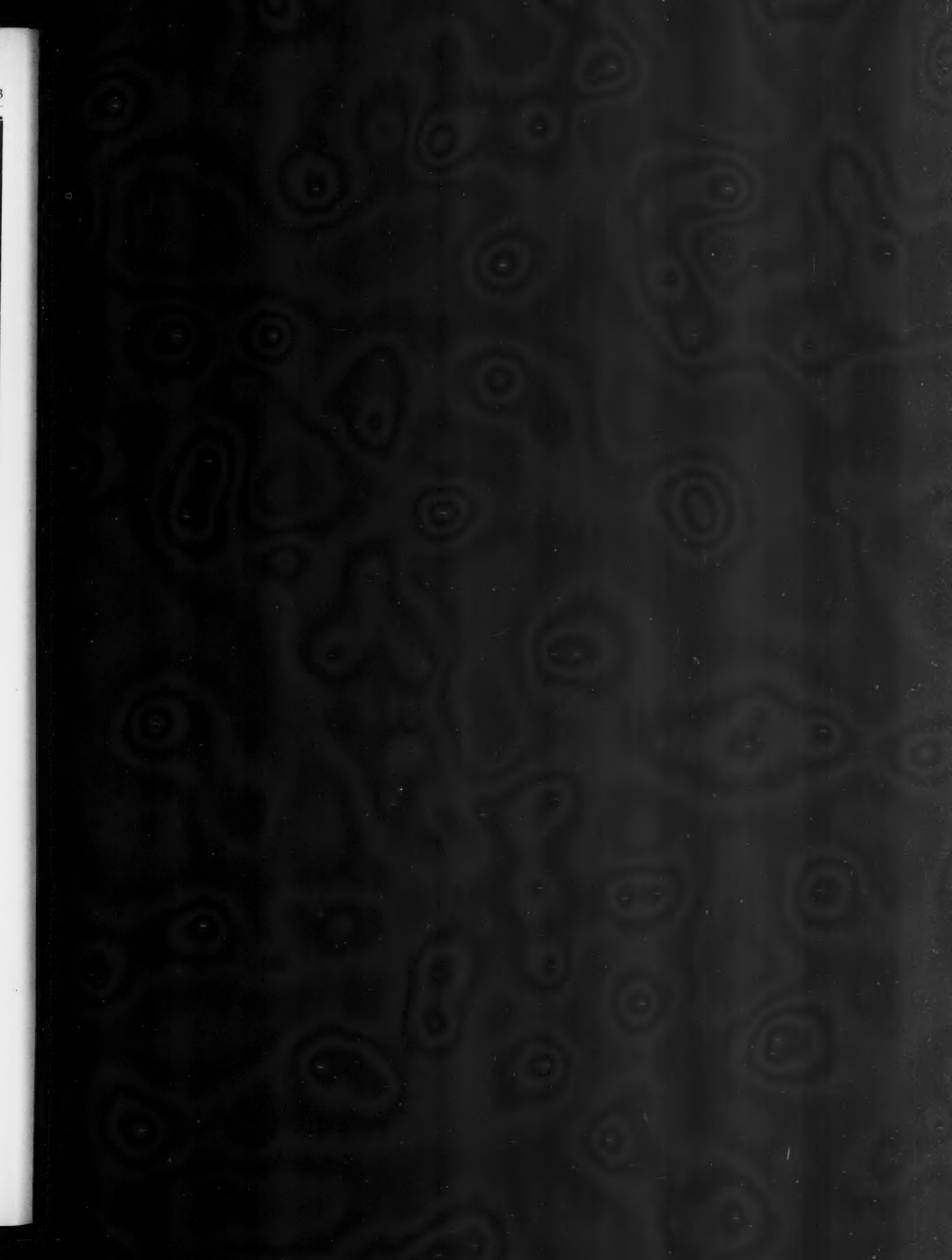

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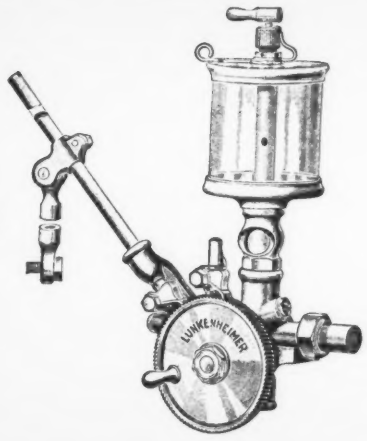

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THE LUNKENHEIMER CO.

Sole Makers,

Branches: New York, 26 Cortlandt St. London, 35 Great Dover St. **CINCINNATI, O. U.S.A.**

MECHANICAL OIL PUMP

NONPAREIL CORK

IMPORTANT NOTICE

We have rebuilt our large factory at Camden, N. J., since being burned out some time ago, and are now ready to supply our Nonpareil Cork Covering for steam, water and brine pipes.

Many of our customers knowing the value of cork as an insulator, have placed orders with us for Cork Covering, to be delivered when plant was rebuilt. If you contemplate purchasing pipe covering for any condition of service, you should find out about cork before placing your order.

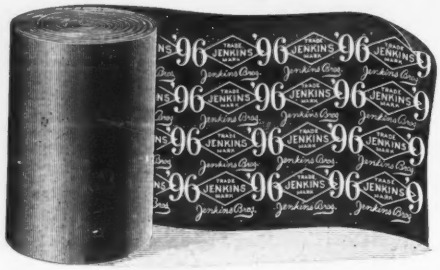
JOHN R. LIVEZEY
1936 SANSOM STREET
PHILADELPHIA

The Nonpareil Cork Mfg. Co.
Gerken Building
Chambers St. and W. Broadway NEW YORK

1208 E St., N. W., Wash., D. C. Builders' Exchange, Pittsburg, Pa. 113 S. Gay St., Balto., Md.

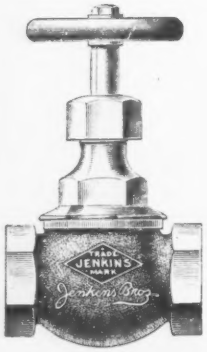
'96 Jenkins Standard '96 Packing '96

The Perfection of Joint Packing. Do not accept unless it bears our Trade-Mark as shown in the cut.



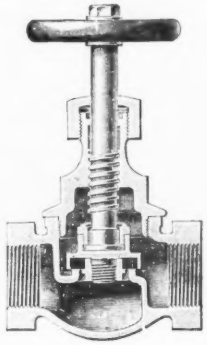
Use Jenkins '96 Sheet Packing on the worst joint you have, and if it is not what we claim we will refund the money.

JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.



Jenkins Brothers' Valves

Designs, workmanship and materials of the highest standard throughout. Every valve inspected and tested before leaving the factory. Made in all styles and sizes, both brass and iron.



Jenkins Discs

Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, Lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water.**

Jenkins Brothers' Pump Valves

Adapted to every pumping requirement, these valves are especially suited for pumping hot water, syrups, beer and other destructive fluids; also muddy and gritty water. When rubber valves have been found useless, these valves have given entire satisfaction.

For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement

We also manufacture a fine grade of Soft Rubber Valves for cold water and air service.

When ordering valves please state for what purpose you desire to use them.

Jenkins Brothers' Valves, Jenkins '96 Packing and Rubber Specialties received the highest Awards at the Pan-American Exposition

All the different specialties are stamped with Trade Mark.

Write for Catalogue

JENKINS BROTHERS

71 John Street	17 Pearl Street	133 N. Seventh Street	31-33 N. Canal Street	62 Watling St., Queen Victoria St.
NEW YORK	BOSTON	PHILADELPHIA	CHICAGO	LONDON, E. C.